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Competition or Co-operation.

A SHORT time ago the Canadian Government, as one of the partners in the Pacific Cable Board, approached the British Government suggesting an inquiry into the future of telegraphic communication as affected by the growth of wireless competition on the "beam" system. This was followed by an announcement by Mr. S. M. Bruce, Prime Minister of Australia, to the effect that such an inquiry was to be made, as experience showed that wireless competition was diverting 45 per cent. of the traffic of the Australian branch of the Pacific Cable system to the "beam" system. Other supplementary statements in the Press indicated that the loss was nothing like 45 per cent. on the ordinary or fully-paid traffic, being chiefly in the cheaper classes. The losses of traffic, it was stated, were not due to any superiority of the beam service, but to lower charges for the latter. There has been some attempt made to compare the respective merits of cable and wireless, and there has been cutting of cable rates to cope with the competition of the rival. It is common knowledge that for many years past the submarine telegraph cable companies have occupied a very strong financial position, their revenues and dividends have been large, and very substantial sums have been put to reserves. The competition from wireless services has been threatening for many years, but until quite recently it has not reached such a point that it has seemed to be necessary to treat it as a menace to cable dividends or to the security and stability of the great cable system with which Britain almost alone has girdled the earth; but at the recent meeting of the Western Telegraph Co. Sir John Denison Pender reported that the company had cut its rates because of the competition.

The situation, therefore, has undergone sufficient change for the matter to be examined with respect to its larger bearings, for though we always have stood and still do stand for the cheapest possible means of communication between the different parts of the Empire and with foreign countries, we can

see no good either for cables or wireless, or for the world at large, in extreme price-cutting in such a connection as this. The separate parts of the Empire have moved in the matter partly on the grounds of defence, and there has been a desire on the part of the Government to facilitate movement in the direction of co-operative development rather than that of destructive or ruinous competition. Sir Geoffrey Clarke, formerly Director-General of Posts and Telegraphs in India, and now joint managing director of the Telegraph Construction and Maintenance Co., Ltd., reviewed the difficulties of the subject at some length in *The Times* of December 1st, and he expressed the view that now that the Government had had experience of the working of both wireless and cables, some definite arrangement should be made in the interests of both. Sir Geoffrey mentioned three courses that he saw open for dealing with the problem, namely:—

(1) The fixation of equal rates for all telegraphs between particular places, with fair competition between wireless and cables.
(2) A joint purse by which all traffic receipts on certain routes should be pooled, and an agreed proportion taken by all parties.
(3) Unified control.

It has since been reported that negotiations are in course of development between the Government and the radio and cable companies with regard to their relative positions, and the Eastern Associated Telegraph Companies in consequence have communicated to their disquieted shareholders the information that, pending development of these negotiations, no further statement can be made.

It is stated that at their own request representatives of the Eastern Associated Companies met Post Office representatives on October 26th to inform them of the cable companies' intended action with regard to wireless competition. The companies, however, undertook to postpone action until the Post Office had been able to consult with other Government departments, and they were assured that before the end of the year the Post Office would be in a position to deal with the situation.

But this announcement of negotiations has led the Marconi Company to publish a lengthy statement of its position, in which it covers a very wide ground. Various points are raised, the discussion of which might not help the controversy at this stage so well as to note that the Marconi Company is prepared to discuss with the cable companies any means of co-operation, "provided always that nothing is done to restrict in any way the free development of wireless." The Company is aggrieved that it has not been invited to take part in any discussions which are proceeding between the cable companies and the Government. The fact that the Government has been appealed to implies, in the Marconi judgment, Government control, and it contends that the relations between the two systems of communication should be discussed between the companies. It also adds that it has no other desire than to be left free to develop its traffic services under the licences granted to it by the Government. Whether one of the systems, and which, is destined to become auxiliary to the other in course of time, is hardly a matter ripe for conclusion at this stage, and the Marconi suggestion that the Government should at once prepare a comprehensive scheme of wireless communication for the whole Empire by which the scattered parts of the Empire can be linked up with the great beam trunk services will doubtless receive Home and Empire Governmental consideration; the Marconi Company records its own preparedness to submit such a scheme.

The best interests of the world will be served by each system being left in such a position that it can pursue its own perfection. The problem—or the present aspect of it—may be a new one, but it has been introduced in good time, and it is one that will not bewilder our statesmen or the eminent men who stand at their posts safeguarding the cable interests of the world, nor will it bring ruination to shareholders in submarine cable companies.

One thing that can be said with certainty is that, according to present appearances, including the obscurity surrounding the question of future international relationships, submarine cable services will be vital to the British Empire, however far the development of radio transmission may be carried. Admitting all that there is to be admitted regarding the marvellous wireless advances of recent years it may still happen that the future cannot be settled by "survival of the fittest" considerations in such a matter as this. Alternative and co-operative means may be essential, and no ultimate good can ensue from one party belittling the war-time achievements of the other. Who, knowing one small part of the wonderful achievements of the cable service throughout the world in wartime, can be unmindful of the imperative necessity for lines of communication to be kept open at all costs? But they cannot be maintained in efficiency if reckless rate-cutting be introduced where paramount interests call for co-operation, though the co-operation must be of such a nature that more and more news will flow from land to land every year at reasonable and economic rates. Press dispatches from Sydney intimate that the question being discussed there is whether the resources of both systems cannot be pooled in such a way as to protect the public in the question of rates without prejudicing private interests. A pooling for a period of three to five years is mentioned, and it is added that the Home and Australian Governments have the matter in their own hands, as they completely control the Pacific cable and own three-fourths of the beam system.

The most welcome feature in the discussion that is proceeding is the desire that seems to possess all parties that there shall be full exploration of the possibilities of adopting co-operative measures.

Economies in Detail.

MOST of the engineering industries have passed through a depressing period of lean years. They are not out of the trough yet, though there are welcome signs of a coming change. Amidst this general slump, however, there have been two notable exceptions—the electrical engineering and the motor-car industries. For these the immediate future continues to promise well. Certainly the electrical industry is experiencing a larger popular demand for facilities and services to the mutual benefit of suppliers, producers and users, and this demand will continue to grow for a long time if all interests co-operate on proper lines; but attractive charges for energy and lower prices for apparatus will go further than anything else to bring success to those who have limited means and are unwilling to adopt hire-purchase systems of payment. Lower prices of certain electrical lines will become possible if producers of goods bend their energies definitely to the task, with reasonable foresight and imagination.

This is a day when full-blooded, thorough-going attention to design and execution is absolutely necessary all along the line. Economic production is *not* secured except in response to detailed attention. The manufacturer whose products are the outcome of over-all and all-through efficiency, economy and excellence, is well in the fair-way to success. It means careful and thoughtful scrutiny in the planning of manufacturing operations as well as equal care in design and execution; it means also close attention to simplification step by step. Concentration upon just such opportunities for point to point economies has enabled the motor industry to turn out private cars at an inclusive price round about ten per cent. below the pre-war figure—this, too, while the cost of raw materials is considerably higher now than then, and wages in the industry in many cases are double what they were in 1914. These are facts which merit most careful consideration. Small things by themselves may not matter so much, though in the aggregate they may represent large annual savings. Especially fruitful is the benefit derivable when the small

economies are interrelated, for the effect may be that of multiplication rather than addition, and the *cumulative* savings may assume really large proportions.

Of course, it has to be admitted that standardisation of parts, mass production methods, and the like, find peculiar scope in the motor industry. The manufacturer of small to medium size electrical machinery is also, in many cases, able to standardise whole lines of such machines. Steam and hydraulic turbo-alternators, for example, on the other hand, are not amenable, at all events in the present stage of demand and supply, to such wholesale regularisation. Even here, however, constant watchfulness is eminently desirable, for, apart from whole-hog standardisation, much may yet be done as regards minor details. Not only parts common to large ranges of machines, such as bolts, screws, rods, hand-railing, hand-railing bases, connections, and stanchions, chequer plating, name plates, &c., but entire details such as brush gear, slip rings, pedestals, bearings, couplings, oil pumps, and the like often prove suitable subjects for at least semi-standardisation in carefully graded sizes. When, too, firm instructions are issued that one or other of these sizes must be chosen for any particular order, departure therefrom being allowed only by the express ruling of the chief of design or drawing office staff, it is possible to secure very considerable and most welcome annual savings.

The issue of data sheets by the Society of Motor Manufacturers and Traders has enabled the number of sizes in a particular item to be reduced progressively from a matter of hundreds to 32, then 11, and finally 6. Such drastic simplification can scarcely be looked for by the manufacturer of electrical machinery, and yet great strides in that direction may be possible. Most concerns would find, on careful analysis of stock and standard sizes of details, that much needless overlapping and ultra-lavishness in alternatives existed. Often the steps are too close, and only a little ingenuity would be needed to reduce them by one-half, or even two-thirds. Over-refinement in grading can on occasion be so much a luxury as to swallow up quite a large percentage of potential profit. Periodical oversight of the authorised parts lists would often give the clue to economies which are available without undue interference with existing facilities.

Close scrutiny and careful attention to the possibilities of *detailed* economy can produce aggregate results which, spread over large batches of work and a period of months, astonish the indifferent and gratify others.

Overhead Line Regulations.

As was indicated in our last issue, the Electricity Commissioners are taking vigorous action in the direction of revising the overhead-line regulations and reviewing the whole subject of electricity supply in rural areas. On Wednesday last week a conference of electrical engineers of electricity supply authorities which they convened took place in London; the proceedings were private.

In the evening of the same day a meeting of the Overhead Lines Association was held at the Institution of Electrical Engineers, and a discussion on the British Regulations, opened by Mr. W. Fennell, M.I.E.E., took place; it lasted for three hours, and was animated and purposeful throughout. Col. R. E. Crompton was present and, being pressed for time, was invited to speak first; as a pioneer in electrical distribution, and an enthusiastic advocate of rural electricity supply, he was heard with interest and appreciation. His suggestion that for the supply of villages storage batteries would prove suitable deserves careful consideration, particularly having regard to the great importance of a high load factor.

To return to the subject of regulations, Mr. Fennell pointed out that the word "facilitate" used in the title of the Act of 1882 meant "to make easy." In the light of subsequent events it sounds ironic; but the reminder is timely, for as things are, the supply of electricity in rural areas is anything but easy. In the author's words, "if the object of the 1926 Act is to be achieved, the regulations must be the very minimum which will secure the reasonable safety of the public," and he showed that electrical undertakers are at present asked to submit to regulations of a stringency which would ruin any other public utility service, if applied to it. The sense of the meeting was entirely in favour of relaxation of the regulations, and it may be added that no extreme measures were advocated—on the contrary, the modifications asked for were moderate and reasonable.

In this connection it is of interest to note that in connection with the large scheme of electricity distribution in North Wales, of which particulars are given in the following pages, we quote the views which are held by the consulting engineers, Messrs. G. V. Twiss and Partners, with regard to the necessity of obtaining the relaxation of regulations, facilities to carry out extensions, &c. This important undertaking necessarily makes great use of overhead lines, and the engineers have felt the need for greater freedom in design.

Cheap Electricity.

In his address as chairman of the North-Western Centre of the I.E.E., Mr. A. B. Mallinson courageously outlined the conditions which electricity has to cope with in an industrial area such as that of South Lancashire. Whereas the working costs of six large undertakings averaged 0.627d. per kWh last year, in hundreds of textile mills, where the capital cost of the plant has been written off, and the plant itself is of high efficiency, the total cost of power is little more than the working cost at the public electricity supply station, and it is impossible to secure them as consumers. When comparisons are drawn between different countries on the basis of electricity consumed per head of population, no account is taken of the unique conditions that obtain in this country with its old-established and admirably engineered industries which have no use for a public supply of electricity. We were glad to see that Mr. Archibald Page, in his presidential address to the Institution, deprecated such comparisons, which, as we have often pointed out, are invalidated by the widely differing conditions that obtain here and abroad.

Mr. Mallinson takes a common-sense view of the matter. He recognises that *improvement of load factor is the keystone of cheaper electricity*; that is a fact which cannot be over-emphasised. Moreover, there are many industries which can never be brought within the scope of public electricity supply—especially those which require large quantities of heat for process working; in such cases electricity is a factory by-product, and its cost is almost negligible. As he justly remarks, it is better to accept the situation and to make the best of it by honestly encouraging the manufacturer to install heat-extraction plant and buying his surplus energy. Only harm can result from misrepresenting the possibilities of electricity.

The Croydon Scheme.

THE approval by the Croydon Corporation of a scheme for the hire-purchase by the Department, in conjunction with local registered electrical contractors, of apparatus and installations appears to settle a matter which caused a little unpleasantness earlier in the year.

In the main the agreed scheme, which is described on another page, is identical with the original one, but the arrangements for sales from the Corporation's showrooms appear to have been improved from the contractor's point of view.

The Corporation has allocated £10,000 to the installation part of the scheme; we hope that this will soon be exhausted and more required. Both the Electricity Department and the contractors will then be satisfied and many more people will have been given the opportunity of benefiting from the public service of electricity.

Rural Electricity Distribution.

A brief account of the work undertaken recently by Electricity Distribution of North Wales and District, Ltd.

ELECTRICITY supply in rural areas now being so prominent a subject of discussion, a description of the undertaking of Electricity Distribution of North Wales and District, Ltd., will doubtless be of interest.

This Company was brought into being in November, 1925. Its issued share capital is £155,500, and the Company also received a further £150,000 in the form of loans guaranteed by H.M. Treasury under the Trade Facilities Acts. It operates in the area of the North Wales and South Cheshire Electricity District, which is served by the transmission-line system of the North Wales Power Co., Ltd., from which the Distribution Company derives its supplies in bulk.

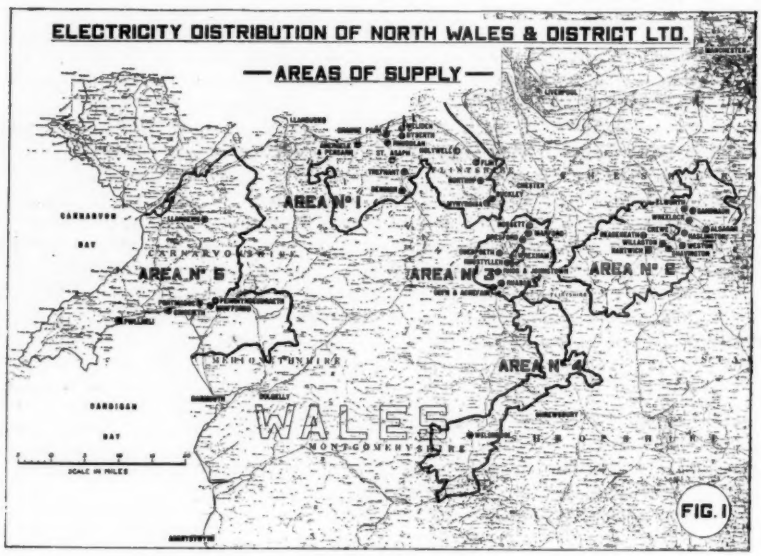


Fig. 1.—Map of the Distribution Company's Area of Supply.

The Company operates under a number of Electricity Special Orders which, for convenience, have been grouped into five administrative areas, as follows:—

Area.	*Special Orders.*
No. 1 (Northern or St. Asaph).	Abergele and Pensarn. Flint and Holywell. Denbigh and St. Asaph Buckley.
No. 2 (Eastern or Nantwich).	Sandback and Alsager. Nantwich and District. Whitchurch and Ellesmere (northern portion).
No. 3 (Central or Wrexham).	Wrexham Rural District.
No. 4 (Southern or Welshpool).	Welshpool. Whitchurch and Ellesmere (southern portion)
No. 5 (Western or Pwllheli).	Pwllheli and Lleyn. Gwyrfai and Ogwen. Criccieth and Portmadoc. Glaslyn and Deucraeth.

The above areas and the towns supplied are shown on the map of the district, fig. 1.

The population of the areas covered by the Special Orders amounts to 274,707, and the present system of mains provides for the serving of over 100,000 people.

Characteristics of Areas.

The areas comprise towns and villages of a widely different nature, and include popular holiday resorts such as Abergele, Pwllheli, Criccieth, &c., a purely mining district in the Wrexham area, country market towns with some industries, such as Welshpool, Nantwich, Sandbach, Denbigh, &c., and many small towns and villages with populations of less than 1,500 persons.

An encouraging feature of the results so far obtained has been the number of applications received from villages in the rural parts of the areas, showing that there is a genuine need for electricity in rural areas, and that the inhabitants of these villages can be relied on to support electricity schemes when the price is reasonable. As an example of this, in the village of Northop, the population of which is approximately 350, representing, say, 70 houses, 52 applications have already been received, although the supply has only just been switched on.

Engineering.

The work has been carried out to the designs and specifications of Messrs. G. V. Twiss & Partners, consulting engineers to the Company, to whom are due the opinions expressed in this article.

Supplies in all cases, with the exception of that for Welshpool, are derived from the Power Company's lines at 6,600, 11,000, or 35,000 volts; the lines, in the majority of cases, have been sufficiently near to make supplies readily available. In the remaining cases, extensions to the Power Company's lines have been built by the Distribution Company under arrangements whereby these extensions become part of the Power Company's system.

General Considerations in Design.

In the cases of some of the towns, including Abergele, Flint, and Denbigh, it was found convenient to bring the main feeder near to the centre of the town and hence of the load, the low-pressure distributors radiating from that centre. In the case of other places where the load is scattered, or there is more than one

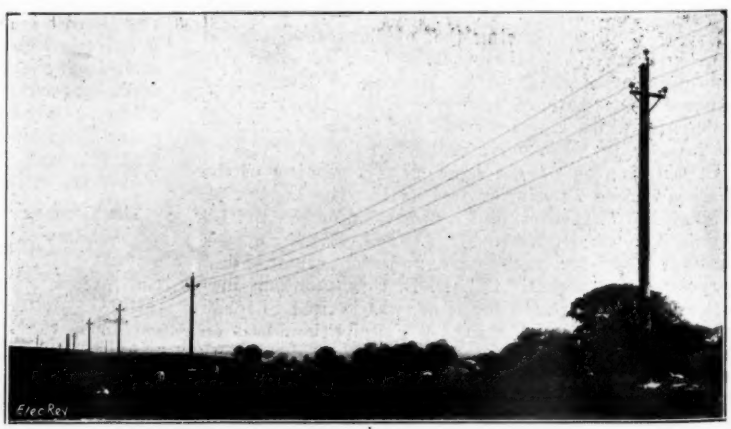


Fig. 2.—Typical E.H.P. Steel-conductor Feeder Line.

concentration of load, the system adopted has been to step down to 3,300 volts and distribute at that pressure to a series of kiosks erected at the several load centres, the low-pressure distributors radiating from such kiosks. This system has been used, for example, at Nantwich, Sandbach, Rhos, and Johnstown.

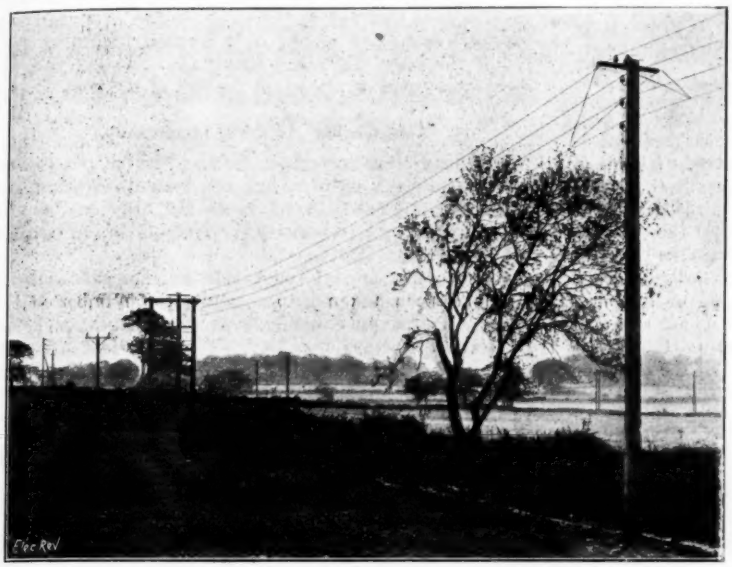


Fig. 3.—Steel-conductor Feeder Line, Sub-station and L.P. Line.

The use of kiosks for 11,000 volts has been avoided as far as possible, as such kiosks should preferably be fitted with an automatic oil switch, and due to this and the consequent size of the kiosk its cost shows little or no saving over that of a brick sub-station.

E.h.p. Overhead Feeder Lines.

In certain cases the minimum size of copper conductor desirable for mechanical reasons has a current-carrying capacity in excess of the requirements, and in these cases steel conductors have been used, with a consequent saving of capital expenditure. Special precautions have been taken to avoid the corrosion of such steel wires.

The feeder lines themselves terminate at an airbreak switch on the pole adjacent to the sub-station, the opening of this switch making the sub-station dead for the purpose of transformer maintenance. Fig. 2, p. 979, shows a typical steel-conductor e.h.p. feeder line serving Holywell. Fig. 3 is a view of a steel-conductor feeder line sub-station (controlled by mast switch) and l.p. overhead line.

E.h.p. Underground Feeders.

Where it has been necessary to install underground e.h.p. feeders, the maximum drum lengths of cable which can be economically constructed in the factory have been used with a view to eliminating joints as far as possible. The joints themselves are of usual design, with the exception that the lead-sleeved joint is enclosed in a creosoted wood box (in place of a cast-iron box), fitted with a steel plate on the cover and filled with more or less plastic pitch.

Protection.

The Company's sub-stations being so widely separated, it was considered that the use of highly sensitive protection was to be avoided, it being important that supply should be maintained in circumstances of transient faults rather than that it should be cut off by sensitive protection which might cause a shut-down of supply for some trivial cause, to remain shut down until the district engineer could be recalled from some other part of his district—possibly a distance of some miles. The only protection devices used on e.h.p. oil switches are overload and time-limit fuses.

Sub-Stations (Indoor).

The sub-station buildings are of a uniform size of approximately 8 ft. by 10 ft., which gives sufficient space to house an e.h.p. switch, metering equipment, transformer, and low-pressure board, whilst room is available for the storage of a spare transformer. The high-pressure switchgear in some cases is of the ironclad

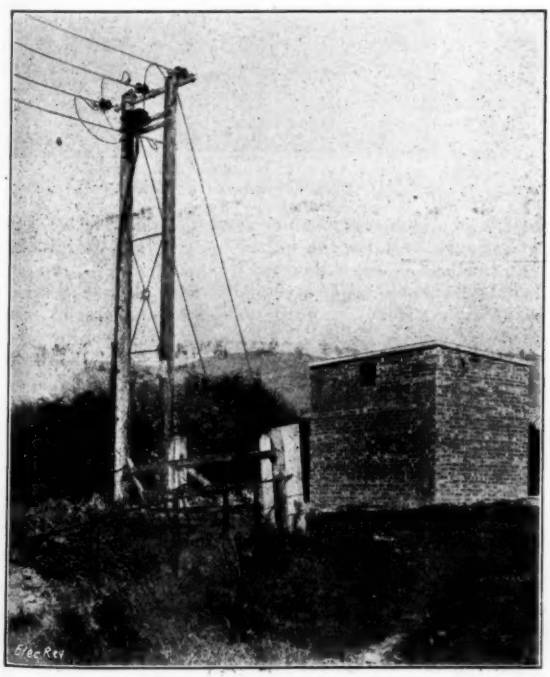


Fig. 4.—Typical Brick Sub-station.

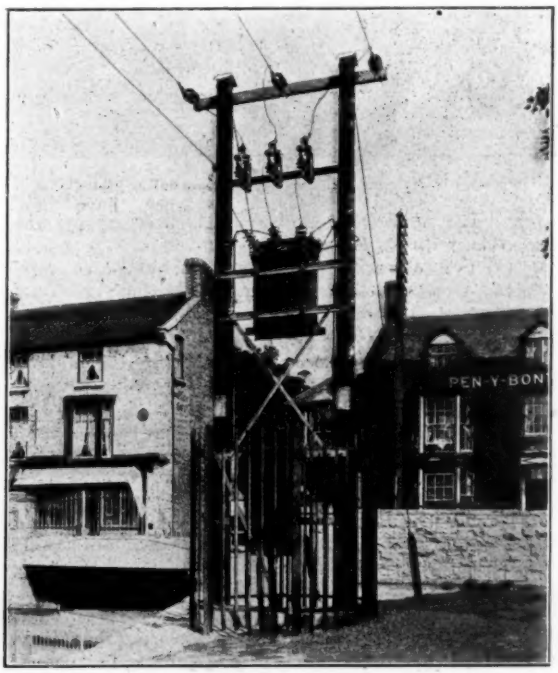


Fig. 5.—Outdoor Sub-station.

type, as at Flint, where the ring-main type of switch with oil-immersed isolator has been installed; in other cases truck-type gear has been installed, as at Criccieth, Meliden, and Grange Park. The low-pressure boards are of the distribution-pillar unit type, the units being bolted to an iron frame supported from the wall. Fig. 4 shows the outside of one of these sub-stations.

Sub-Stations (Outdoor).

The construction of outdoor sub-stations has been kept as simple as possible, the structures (see fig. 5, which is typical) being usually H-poles fitted with e.h.p. fuses, a transformer hung on cross members, and a low-pressure switch and metering cubicle also mounted on cross members. The design is such that the erection or removal of a transformer is a simple matter, the top cross-arm being of heavy section so that tackle may be fastened thereto for the purpose of raising or lowering the transformer. The other gear mentioned above is placed on the opposite side of the pole to the transformer, leaving a clear run down for the transformer in such circumstances. The sub-station structures have been designed for a capacity of from 25 to 250 kVA without material alteration. Fig. 5 shows a typical example of an outdoor sub-station.

In certain cases, as at Northop, it was necessary to tap a double-circuit 35-kV line to give a supply to the town. The conditions under which this supply was available were as follows:—

(1) that either circuit would be out of commission at the Power Company's option;
(2) that the two circuits must in no circumstances be paralleled.

The first condition necessitated the tapping of both circuits, and for this purpose two transformer sub-stations were erected, one on each side of the transmission line, these sub-stations being each isolated from the transmission line by the insertion of airbreak switches, and interconnected by low-pressure cables.

The second condition was met by designing the control gear of the airbreak switches so that one operating handle only is used for the two switches, the handle being removable only when the switch is in the open position.

Metering.

Metering is carried out at the indoor sub-stations on the high-pressure side of the transformer, the meters, supplied by Messrs. Landis & Gyr, Ltd., being fitted with maximum-demand indicators and mounted on the high-pressure switch panel. At outdoor sub-stations, however, metering is carried out on the low-pressure side of the transformers, the meters being contained in the cubicle mentioned above. In this case transformer losses are computed and added to the meter readings for the purposes of payment for the bulk supply.

Distribution Network (Underground).

The joints of the low-pressure cables have been made in a similar manner to the e.h.p. joints in so far that the lead boxes are placed in a wooden box filled with pitch, the only difference being that in this case no sheet-steel cover is placed on the top of the box.

Distribution Network (Overhead).

Overhead lines have been used wherever practicable and where local opinion has not been overwhelmingly against their use. In all cases the overhead system has been designed to carry 4-wire, 0.1-sq. in. distributors.

In the designing of the overhead lines, the æsthetic view has been taken into account, the number of fittings on the pole being kept to a minimum; the cross-arm necessary for the "V" guard is fitted close to the top of the pole and is utilised for the support of one of the phase wires and the street-lighting wire. Fig. 6 shows a typical low-pressure line.

It will be noticed from the various illustrations that the cross-arm has been placed centrally with the pole and not with the wires, thus giving a balanced appearance to the pole structure, although the guard itself (which is much less visible) is not symmetrical. The tension of the wires themselves has a great deal to do with the look of the completed line, and in all cases the conductors have been strung to the highest tension permissible without unduly increasing the cost of terminal and angle poles. These minor points add considerably to the appearance of the lines, and therefore facilitate the obtaining of consents, as experience shows that the local authorities which are likely to object to their use are those whose councillors have already experienced annoyance from lines in other towns which have been erected without due regard for appearance.

Fig. 6.—Low-pressure Distribution Line.

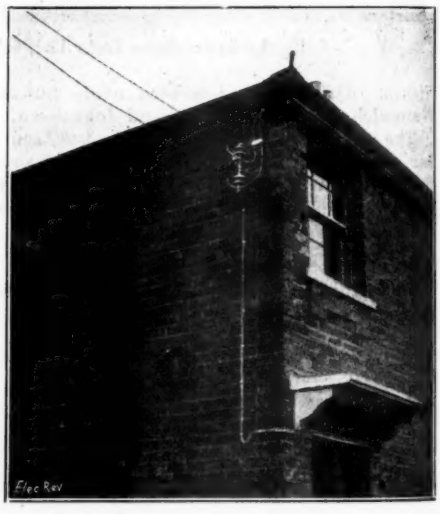


Fig. 7.—House-service Bracket.

House Services.

A special overhead house-service bracket was designed, consisting of one-inch gas tube fitted with two reel insulators, which forms a neat arrangement, as indicated by fig. 7. The service line necessarily comes into the house from the nearest pole, and hence at varying angles, and this design adequately deals with this condition.

Consents, Wayleaves, Regulations, &c.

There is at present a considerable expression of opinion relative to the necessity for the simplification of procedure, easement of Commissioners' Regulations, and abatement of Post Office requirements with regard to overhead lines in the interests of electrical develop-

ment, particularly in rural areas. The present case of distribution in North Wales is a fairly comprehensive and recent example of such electrical development, and the following observations are made in this connection:

Wayleaves and Consents of Councils to the Use of Overhead Lines.—The difficulty regarding wayleaves and consents is a very real one, and the Distribution Company was frequently faced with the necessity of either laying underground mains or being hung up for an inquiry. In these cases the Company decided to steer a middle course, and in a number of cases agreed to lay underground mains in the main streets where the Councils (not without some justification) insisted on it, the Councils giving their consent to the use of overhead lines elsewhere in their towns or districts. By these means, and generally by the exercise of considerable tact, the Company was able to get on without a single inquiry and its consequent delay. The business of getting wayleaves and consents, however, must necessarily keep any Undertaker on tenterhooks, and any simplification or relief in this respect would be a boon.

Consent of the Minister of Transport to Overhead Lines.—The procedure necessitating consent being obtained to every extension is very tedious and time-wasting. It is understood that there are technical difficulties in the way of general consent being given, as in the case of underground mains. It has been found, however, that much of the trouble of making numerous applications for extensions can be obviated by showing on the map accompanying the application for the original consent all future extensions which may eventually materialise.

Regulations.—The necessity for special guarding (V guards and insulators in the stays) for low-pressure a.c., which is not required for low-pressure d.c., is hard to justify, especially when it is borne in mind that tramway conductors at 550 V d.c. (which are necessarily subject to wear and hammering) are not required to be guarded. Moreover, the special guards required for a.c. distribution may themselves add to danger. If, therefore, the requirements for a.c., which are additional to those for d.c., were abolished, and further, if clearances could be reduced to, say, 17 feet, an important saving would be shown, and it is not considered that this would encroach upon reasonable standards of safety and continuity of supply.

No difficulty has been experienced due to the regulations which require sags and stresses to be calculated on a combined wind and ice load, which, it is considered, gives the most economic construction consistent with uniformity of strength with different sizes of conductors under varying weather conditions. As an example of this uniformity, in the storm which recently swept the area (stated to be one of the most severe in living memory) no single line came down, though the sizes of the conductors vary very considerably. Such strength, however, indicates that the Regulations may impose a greater all-round strength than is strictly necessary, and it is suggested that the authorities might be prepared to consider shading off a little of the load whilst still keeping to the principle of a wind and ice load, for instance, by reducing the $\frac{1}{4}$ in. of ice to, say, 3/16 in. of ice.

In view of the fact that practical experience in Great Britain now shows that lines designed for $\frac{1}{4}$ in. of ice do not come down, there would also seem to be practical grounds for shading off the $\frac{1}{2}$ in. requirements in the case of high-pressure lines, for instance, to $\frac{3}{8}$ in., and eventually possibly to $\frac{1}{4}$ in. if experience shows that all lines continue to stand up to the requirements, notwithstanding the decrease in assumed load.

With overhead lines over so widespread an area, as was only to be expected, arrangements have had to be made in a great many cases with regard to the lines crossing, or in proximity to, Post Office wires, and this has necessarily involved appreciable additional expenditure. At the same time, it is acknowledged that the attitude of the Post Office officials has always been one of co-operation rather than otherwise.

Contractors.

The following are the main contractors who carried out the work in the several areas:—

Messrs. Crompton-Parkinson, Ltd., No. 1 Area.

Messrs. British Insulated Cables, Ltd., Nos. 2 and 4 Areas.

Messrs. Siemens Bros. & Co., Ltd., part of No. 3 Area.

Messrs. W. T. Henley's Telegraph Works Co., Ltd., parts of Nos. 3 and 5 Areas.

Messrs. Johnson & Phillips, Ltd., part of No. 5 Area.

General.

The construction in a large number of the areas has now been completed; supplies are already being given to some 40 towns and villages, and consumers are being rapidly connected.

The Company is pusuing a vigorous sales policy, and a two-part tariff has been adopted, comprising, in the case of domestic consumers, a fixed charge according to the number of rooms, with a low unit charge for current.

We are indebted for the above details to the consulting engineers, Messrs. G. V. Twiss & Partners, and for permission to publish the same to the directors of the Company.

Pulverisers or Stokers?

A comparison between the methods of firing furnaces for steam generation; criticisms of the claims put forward for pulverised-fuel equipment.

By E. B. PAUSEY, A.M.I.E.E.

EXTREME interest is being taken at the present time by all power station engineers in the question of the relative advantages and disadvantages of the new system of firing boilers with pulverised fuel and the older system by means of mechanical stokers. All sorts of claims are made for the new method by its partisans, and if we are to accept them all at their face value there will not be a good word to be said for the poor old mechanical stoker. We seem to be on the eve of a revolution in the matter of boiler-house equipment, as drastic as that which occurred 15 or 20 years ago, when the steam turbine swept the reciprocating engine out of the electricity supply industry. Now, there can be no doubt that the success of the steam turbine was entirely due to the very great advantages it possessed over its older rival; it was much more efficient and much cheaper, it required less space, cost less for repairs and maintenance, could be made in larger sizes, was more flexible, it could carry overloads more readily, and make use of considerably higher pressures, temperatures and vacua; there was no single direction in which the new prime mover did not easily outstrip its competitor. The purpose of the present article is to discuss whether the advantages—if any—of pulverised-fuel firing over mechanical stoking are at all comparable with those which raised the steam turbine to its unassailable pre-eminence.

First let us consider the main question—that of efficiency of combustion and of recovery in the boiler, superheater, and economiser. Here, if anywhere, the new

system should show itself decidedly superior. Claims are made that with pulverised fuel the CO_2 percentage can be carried as high as 16, and that efficiencies of well over 90 per cent. can be obtained on test. It is also suggested that the heat from a pulverised-fuel furnace is made better use of by the boiler, in that the gases are discharged to the chimney at a lower temperature than when stoker firing is used. Other claims are that the cost of repairs and maintenance is lower with the pulverised-fuel boiler than with mechanical stoking, and that the former is able to burn low grades of fuel which would be very difficult to burn on a stoker. If the new system has definite advantages in these respects then it must inevitably triumph, and the mechanical stoker will become as rare as the reciprocating engine; but if its advantages are not certain and strongly marked the decision between the two systems will become a matter of some difficulty. It seems to me that now, when we stand as it were at the parting of the ways, we should pause to consider very carefully the pros and cons of both systems.

There does not seem to be much doubt that the new system enables very high percentages of CO_2 to be maintained, of the order of 16 per cent., and this seems at first sight to be an unanswerable argument in its

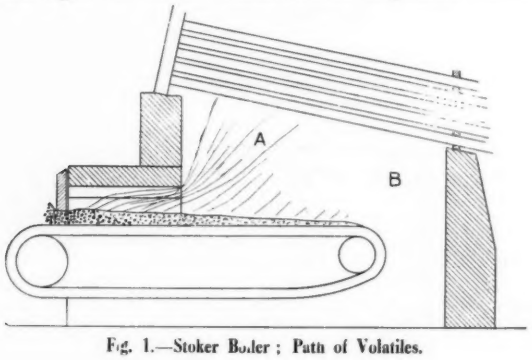


Fig. 1.—Stoker Boiler; Path of Volatiles.

favour. Mechanical stokers have been unlucky in this respect; they have been hampered by theories based on guesswork and traditions having their origin in the dark ages of the haystack and waggon boilers, and in consequence it is rare to find them giving the very high efficiencies and good service of which they are capable. At one time it was very widely held, and the belief still finds a fairly wide acceptance, that the most economical percentage of CO_2 to be obtained with a chain grate was between 8 and 10 per cent.; it is difficult to see what evidence could have led to such a belief, and it would be very instructive if one could compute the number of tons of coal that have been wasted during the present century by those engineers subscribing to this error. The fact is that with an ordinary chain grate, having the usual small combustion chamber over the grate, and burning low-grade bituminous slacks having ash contents of the order of 25 per cent. and (lower) calorific values of about 8,500 B.th.u. per lb., there is no difficulty whatever in maintaining the CO_2 at between 13 and 14 per cent., a figure which implies an efficiency of 80 to 85 per cent., according to the extent and disposition of the heating surface. It is found that the factor which puts a limit to the percentage of CO_2 attainable is the size of the combustion chamber; with the small chambers usually provided there is not time for the combustion of the volatiles to be completed before the gases are cooled below the temperature at which rapid combination takes place by their entering the spaces between the tubes, unless the amount of excess air is considerably increased. If we compare these wretched little combustion chambers with the enormous chambers which are found necessary for the successful combustion of powdered fuel, we cannot but perceive that herein lies, to a great extent, the secret of the pulverised-fuel burner's success. Not only are these combustion chambers of very great size, but the path of the gases through them is so arranged as to take the utmost advantage of every cubic foot they contain. On the other hand, not only are the combustion spaces over most mechanical stokers small, but such space as they contain is by no means made full use of. In fig. 1 is shown a water-tube boiler with a mechanical stoker; it will be seen how quickly the stream of volatiles A given off from the green fuel under the arches reaches the tubes, and what a large proportion of the space B at the rear of the grate is of prac-

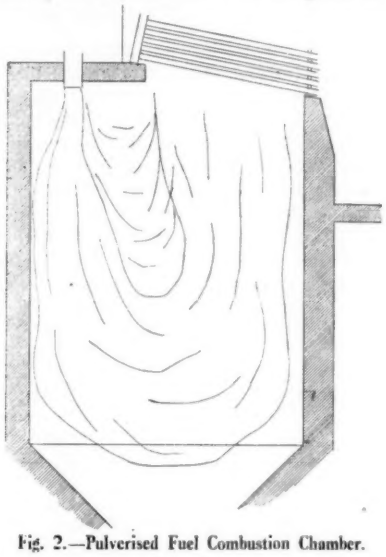


Fig. 2.—Pulverised Fuel Combustion Chamber.

tically no use from the combustion point of view. On the other hand, in fig. 2, a pulverised-fuel boiler, it will be seen how the stream of burning fuel passes downward and sweeps round through the whole of the combustion chamber space before reaching the water tubes, and this enables the finely divided fuel to be completely burnt while suspended in the stream of gas. In the case of a stoker-fired furnace the fixed carbon is burnt as it lies on the surface of the grate and in a shallow zone immediately above it, while the volatiles, which

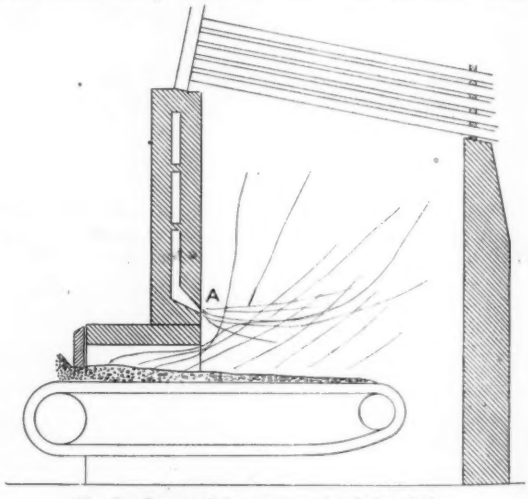


Fig. 3.—Suggested Arrangement for Stoker Boiler.

may represent from 20 to 40 per cent. of the total calorific value, are burnt in the space between this zone and the water tubes. It is obvious that, if the two systems are to be placed on an even footing, it will be necessary for the volume of the combustion chamber of a stoker furnace to be not less than 20 to 40 per cent. of that for a pulverised-fuel furnace of equal output, and for it to be so designed as to be as completely made use of. That is far from the case at the present time. What is required is a combustion chamber at least 6 or 8 feet higher than those at present used with stokers, and some arrangement to prevent the

gases taking the shortest path across it to the tubes. I suggest that the arrangement sketched in fig. 3 will meet these requirements. Immediately above the fire arches is a chamber in the brickwork communicating with the interior of the combustion chamber by a row of small passages, which are directed downwards, and by means of which a number of high-velocity jets A of highly preheated air are directed into the stream of volatiles issuing from under the arches in such a manner as to break up the stream from a steady to a turbulent flow, and to carry a considerable proportion of them into the dead space at the rear of the combustion chamber. With such an arrangement, which need present no difficulties in either construction or use, there is no reason why the amount of excess air used need be any higher than that necessary for the combustion of pulverised fuel. I think it must therefore be admitted that nothing more than proper design is required to put the mechanical stoker on a level with pulverised fuel as regards the production of high CO_2.

The claim that the pulverised-fuel boiler can make better use than the stoker boiler of the heat applied to it cannot be maintained if the latter can be made to give as high a CO_2 as the former. The higher the temperature of the substances in the combustion chamber the greater will be the proportion of the heat given off in the form of radiation, and as the radiant heat must all be taken up by the heating surfaces nearest to the source of heat, it follows that with the higher percentages of CO_2 the amount of heat remaining to be dealt with by the surfaces which are not exposed to the direct radiation from the fire will be less than with lower CO_2 percentages. The temperature of the gases at the chimney will therefore tend to be lower. This is, however, not a matter of systems of firing, but of CO_2 percentage, and, given equality in this respect and in efficiency of baffling, there is no reason why there should be any difference between them in regard to heat recovery.

The repairs and maintenance of stoker-fired boilers often cost far more than is justifiable; this I believe is owing to excessive overloading, a policy that is particularly punishing to arches and side walls. Under proper working conditions the cost of repairs for a stoker-fired boiler, properly operated and carefully maintained, would be between $2\frac{1}{2}$ and $3\frac{1}{2}$ pence per ton of average coal fired. Assuming that the coal used costs 16s. at the stoker hopper, the cost of repairs and maintenance is only about 1.3 to 1.8 per cent. of the total cost of raising steam. Even if a small saving on this be possible its effect cannot be very important. On the score of reliability, too, the new system can hardly offer much improvement over the old; stokers and furnace brickwork, when properly operated and looked after, are extremely reliable, and need cause no sleepless nights to the man responsible for them. There is, indeed, one direction in which the powdered-fuel system appears to me to be a distinct disadvantage: if for any reason the supply of electricity to the motors operating the apparatus for feeding the fuel to the burners fails, which most likely would be due to some small cause such as the accidental blowing of a fuse or operation of a local circuit breaker, it would seem that the flame must immediately go out, and all the boilers so affected would quickly cease to deliver steam to the turbines, thus turning a minor mishap into an event of major importance. In the case of a stoker-fired boiler a parallel kind of mishap would be the stoppage of the stoker motor; in this event the matter would not be at all disastrous, for the burning fuel lying on the grates would be quite sufficient to maintain the steam for a few minutes while replacing the fuse or circuit breaker, or starting up and putting in service the stand-by stoker motor. *(To be concluded.)*

Profit Sharing and Labour Co-partnership.

An examination of the principles and purpose of the movement, and a consideration of its suitability for adoption by the electricity supply industry.

By A. W. W.

THERE has been a considerable amount of discussion recently on the merits of profit sharing and labour co-partnership schemes as a means of securing closer co-operation between labour and management, and introducing greater harmony into industry. It must not be thought, however, that the prime object of the profit-sharing movement is to improve industrial relationships. The main idea is to increase production or improve the efficiency of production by offering the workers a share in the resultant increased profits. True, the scheme does tend to create a better spirit in industry, but to do this the bonus representing the share of profits must be a separate payment over and above the standard or normal wage for the job in question. This extra payment must not be made at the expense of the ordinary shareholder, nor should it come out of the consumer's pocket as a result of any increase in price of the finished product. The essence of the whole idea, therefore, is that the scheme must pay its own way or fail.

The movement is by no means a new one, and in this country it has had a life of nearly one hundred years. During its century of existence, however, only 550 firms have adopted the idea, and at the end of 1926 there were about 280 surviving schemes under which some 200,000 persons were benefiting. These statistics certainly make a very poor showing, and there would admittedly be justification for assuming on the face of it that the idea had little practical value. This is in a measure true, for, as a matter of fact, if it is possible to reward individual workers for increased production in direct proportion to their increased efforts, such a method is likely to show better results than a profit-sharing scheme. This line of action, however, is not open to all industries since it is often impossible to measure what part of the final product represents the contribution of any particular worker employed. In such a case one of the few practical methods of increasing efficiency is to give the worker a financial interest in the profits of the concern, so that he feels that he is working for himself as much as for the firm.

This scheme is by no means perfect, for an extra effort on the part of the worker may be nullified by bad conditions of trade or by mismanagement, while he may make no extra effort and yet, if general conditions are good instead of bad, he may receive quite a substantial bonus out of profits. In fact, the personal effort of the worker may have little to do with the bonus that he receives. This is largely unavoidable, but the knowledge that he will share in any profit above a certain amount, and that the company cannot make great profits out of his efforts unless he gets some benefit,

certainly tends to establish a better feeling and usually results in increased efficiency.

Partly due to this imperfection, even in its limited field of application, the scheme has by no means met with universal success. Although the scheme has in some instances failed miserably, in others remarkable success has been achieved. Indeed, of the total number of persons covered by the existing schemes, it is estimated that nearly a quarter are members of one industry—that connected with the supply of coal gas. This is not a mere chance occurrence.

The reason for most of the failures of the co-partnership idea has been the inability to make sufficient profits during periods of depression to pay a bonus. In such a case the worker either loses all interest in the scheme or feels that he is not getting a square deal and only very rarely does the scheme survive. In the gas supply industry, however, owing to the monopolistic nature of the undertaking, a fairly steady profit is assured and increased efficiency is almost certain to be reflected in increased profits.

Many other failures have resulted from the method of actually carrying out the scheme. The most satisfactory method of securing a real interest in the concern on the part of the worker is to pay part or whole of the bonus in the form of shares in the capital of the company. In an industry such as the gas supply business which calls for a heavy annual capital expenditure, this method of payment does not hold any great danger, but it is obvious that in the case of a stationary or declining trade there would be a considerable risk of over-capitalisation.

Thus we see that in regard to the two factors that have undoubtedly led to most of the failures of the co-partnership idea, the gas industry stands at a considerable advantage compared with many other industries This advantage is shared by the electricity supply industry, and it is felt that from its general suitability in other respects the electrical industry should experience equal success in following the example set by its rival.

Even if the nature of the industry is suitable for the adoption of a co-partnership scheme, however, the scheme is almost certain to fail if it is not backed by the complete confidence of the workers. How this complete confidence is to be established is obviously a problem for each separate company. The foundation of confidence is knowledge and this implies a full disclosure of the company's accounts and sufficient intelligence on the part of the worker to understand the published figures. In the case of an electricity supply company this should not present an insuperable difficulty, but it is apparent that many concerns might find it very detrimental to their interests to publish full accounts, while an industry employing a considerable proportion of unskilled and uneducated labour would find the idea impracticable.

Every co-partnership plan should involve a sharing in profits, a sharing in ownership and a sharing in control. The extent to which these three factors are to be applied and also the actual method of securing them must be decided separately by each company. It is impossible to fix a scheme suitable for universal adoption, and a method that had been found extremely successful in one industry might fail ingloriously in another. Nevertheless, there are certain general lines which must be followed if the plan is to be a success. In the first place, the scheme must be entered into wholeheartedly and its object must not be to depress wages. Neither should it be used to tighten the hold on the worker or to hinder the mobility of labour. If care is not taken to avoid these elements the scheme is doomed to failure before it is started, since the antagonism of the workers and of the Trade Union would most certainly be aroused. If it is to offer an incentive that appears worth while the bonus must be fairly substantial. At the same time, however, it must be strictly in proportion with the economy of production and must pay its own way. The actual basis of the distribution of the workers' share of profits will also call for a carefully considered judgment. It should be arranged to take into consideration, among other things, the length of service, the salary or wage received, regularity of attendance, and conduct. Care should be taken in this respect to avoid, as far as possible, creating any element of jealousy or laying oneself open to the charge of favouritism. As a matter of fact it is a moot point whether it is not better to leave the method of the actual distribution of the share of profits to be determined by a committee elected by the men themselves. Another point that must be given consideration is the regularity and frequency of the distribution. If the payment for to-day's increased effort is delayed until twelve months' time, because of its comparative remoteness, it will not offer so great an incentive as a quarterly distribution. On the other hand, it must be remembered that the quarterly bonus might be so small that its value would be negligible and an annual bonus would be necessary to offer any real incentive. As regards the agreement itself, the plan should be quite definite and the actual terms should be as simple as possible. The risk of so hedging the worker in with petty restrictions that he is prevented from taking any real interest in the scheme should also be most studiously avoided. The degree of participation in management will call for careful consideration. Sharing in management is not intended to mean that the worker should have a right to interfere in the details of the administration of the business any more than an ordinary shareholder, but he should have a voice in settling the general policy of the business and electing the directors who are to carry out that policy.

A decision will also have to be made concerning the advisability of inducing the worker to invest any of his personal savings in the company. This idea of employé-shareholding is a comparatively recent development aiming at giving the worker a much deeper and keener interest in the company, and it is considered a very valuable adjunct to an ordinary co-partnership scheme. It usually involves offering shares at a discount compared with the current market price, making arrangements for payment by instalments or offering very attractive rates of interest. The scheme thus tends to increase the danger of over-capitalisation, but perhaps the most serious objection is that it may involve the worker in "putting all his eggs in one basket" so that he is liable to lose both his job and his savings at the same hazard.

This multivariety of problems may tend to deter management from adopting the scheme, but it is confidently felt that in the case of an electricity supply company the trouble taken in drawing up a really sound scheme would be more than repaid by the many advantages resulting from its adoption. It must be appreciated that the scheme cannot succeed if it is adopted in a half-hearted way, but where the employer is genuinely anxious to give his workers a square deal the profit-sharing idea deserves close examination as a means of increasing the efficiency of production and of introducing a more amicable spirit into industry.

Train Collision Report.

The official report has been issued of the investigations into the circumstances of the collision which occurred in September last between West Ham and Plaistow stations, on the Tilbury section of the L.M. and S. Railway, when a down passenger train from Fenchurch Street struck a goods train leaving the Plaistow sidings. It was a clear case of failure of the passenger train driver to observe the danger signals. Some tank wagons of the freight train were derailed and fouled the adjoining "up" electric local line, resulting in "arcing." There was some delay in getting the electricity supply cut off, due, it appears, to delay in advising the supply sub-stations of the trouble.

Accumulative Anode Detection.

An adaptation of the well-known resistance-coupled audio-frequency amplification circuit for signal rectification purposes, and its employment as a Moullin voltmeter.

By ERNEST W. BRAENDLE, A.M.I.E.E.

IN recent years much has been done to improve the various electrical circuits employed for the reception of broadcast wireless telephony with respect to sensitivity, selectivity, and quality, all three interlinked and fundamental in their requirements, but by no means simultaneous in their presence. For instance, a selective circuit is often far from being a sensitive one, or, for that matter, one likely to produce good quality, and it is therefore often necessary to make a reasonable sacrifice in the remaining two when trying to attain perfection in one particular direction.

It is not, however, proposed to discuss the why and wherefore of this situation, but to put forward an old circuit adapted to a new purpose, its objective being quality.

Signal Rectification.

Almost everyone is acquainted with the resistance-coupled circuit shown in fig. 1, which is used for the amplification of audio-frequencies, but it is not generally realised that the same circuit is capable of extremely good rectification when suitably designed.

Both valves are so biased as to operate only on the straight portion of their plate current-grid voltage

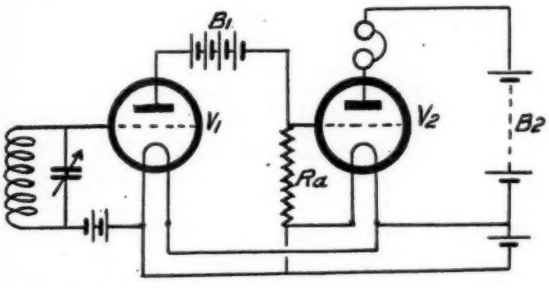


Fig. 1.—Resistance-coupled Audio-frequency Amplification Circuit.

characteristic curve, and "bend" rectification does not enter into the discussion. Actually, neither valve may be truly referred to as the rectifier, as rectification really occurs across the resistance in the anode circuit of the first valve, and is due to an actual accumulation of potential across this resistance, hence the name assigned to the method.

In order to understand the operation of this circuit as used for the purposes of rectification, it is necessary to refer to fig. 2, which may be called the fundamental circuit, since it is on this that the whole theory is based, and, although the simple circuit (fig. 1) may be employed for the purposes of broadcast reception, the fundamental circuit is actually necessitated when it is desired to rectify frequencies of a lower order.

Battery B_1 (fig. 2) causes a current to flow through the valve V_1 and the resistance R_a. The magnitude of this current, under what may be termed static conditions, is dependent on the conductivity of the space between the anode and filament of V_1, which is controlled, mainly, by the potential applied to its grid and, in a lesser degree (in the ratio of its magnification factor), to the potential fall across it. Therefore, if this valve, whose grid is correctly biased, has a rising and falling potential applied to its grid, a corresponding rise and fall of current will pass through R_a with a consequent increase and decrease of potential across it, and therefore across the space between the grid and filament of V_2. In this way the circuit is employed as an audio-frequency amplifier in the condition shown by fig. 1.

Consider now the same condition happening with the circuit of fig. 2 when the capacity C is inserted. It is true that the potential across R_a will increase as the conductivity of V_1 is increased, but such increase will cause extra energy to be stored in C of the order of $1/2K\ (E_2-E_1)^2$, where K=capacity of C in farads and (E_2-E_1)=the increase of potential across R_a in volts. If, now, the conductivity of V_1 is decreased, the current flowing in the circuit will be reduced. It does not follow, however, in this case that the potential across R_a will fall in proportion, since the condenser C has first to discharge its superfluous energy. Since the potential maintained across C and R_a is in opposition to that of the battery B_1, and never greater than it, it is obvious that C cannot discharge itself in that direction, and therefore has to do so through R_a, thereby tending to maintain the current flowing through it, with a consequent prolonged rise of potential across the grid-filament space of V_2. The length of time during which this rise will be maintained is dependent on the size of the condenser C and on the value of the resistance R_a, their combined relation forming a time-constant: therefore, if the time-constant is small in relation to the frequency of the potential variations

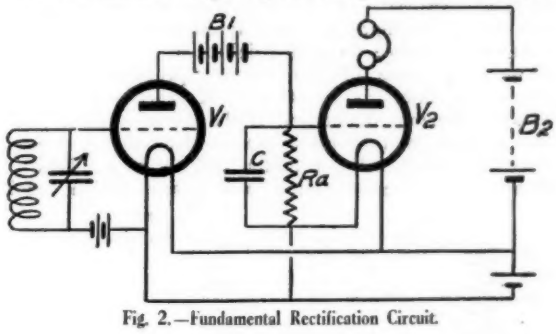


Fig. 2.—Fundamental Rectification Circuit.

across the grid-filament space of V_1, then the circuit will operate as a normal amplifier, but, if the time-constant is great, there will then be an overall increase of potential across C, the value of which will fluctuate or remain constant as the intensity of the potential variations across the grid-filament space of V_1 varies, and a system of rectification will be brought into being. It may be mentioned that placing C between the anode and filament of V_1 will have the same effect, but, although perhaps the method of argument is slightly different, it is not sufficiently important to warrant its insertion here.

In order for this to be of use for broadcast reception it is necessary that the combination of C and R_a shall be such as to give a time-constant as large as possible in relation to the radio-frequencies being received, but sufficiently small in relation to the audio-frequencies. Obviously there are an infinite number of such combinations, but for wave-lengths up to 1,500 metres the self-capacities of the valves themselves, in combination with a 1-2 megohm resistance, are quite satisfactory. In practice the grid-filament of V_2 is not only operated by fluctuations of potential across R_a, but is also dependent for its correct grid-bias on the steady potential dropped across it. It is therefore necessary that the correct relationship of the battery B_1 to V_1 and R_a should be considered by the designer, and that the grid-filament of V_2 should be so biased as to be in the middle of the grid voltage-plate current characteristic curve when the carrier-wave from the station to be received is tuned in to the desired intensity.

In the actual circuit employed by the author (fig. 3), the valves used are, in order, "Cosmos" SP.18 (blue spot), DER and SP.55 (red spot). This gives more

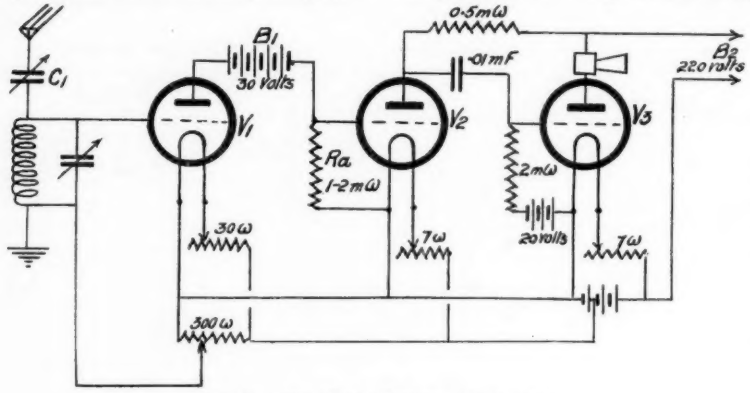


Fig. 3.—Actual Circuit Employed by the Author.

than ample strength from 2LO 10 miles S.E. thereof, and comfortable strength from Daventry, many foreign stations being just audible on the loud-speaker when 2LO is closed down. However, for those who desire a very simple set, but do not desire a reserve of volume from 2LO, the two-valve set outlined in fig. 4 will be found adequate; the valves used are "Cosmos" SP.18 (blue spot) and SP.18 (red spot) respectively. In fig. 3 the variable condenser C_1 is used solely for coupling.

What, then, are the benefits to be obtained from this form of rectification? Briefly, they are that the circuit cannot oscillate at radio frequencies and thereby cause interference to one's neighbours, not to mention serious distortion of one's own reproduction. The circuit is almost as sensitive as if reaction were employed. Serious distortion, if the set is correctly adjusted, does not take place, since rectification is dependent on a straight-line function and not on a "bend." Simplicity of construction and manipulation, and economy of filament-current consumption are other features, since the SP. 18 (blue spot) valve works quite

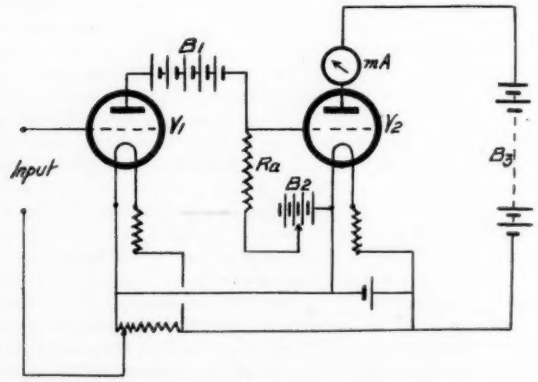


Fig. 6.—Arrangement of Moullin Voltmeter Circuit.

well with only 0.9 to 1.1 volts on its filament and an anode consumption of from 2 to 4 micro-amperes.

To substantiate the theory expressed earlier, it is necessary for the current consumed from the battery B_1 (fig. 2) to be greater as the intensity of the incoming signal increases (this is noticeable on a micro-ammeter), since a higher potential is maintained across R_a. The reason for this is perhaps best demonstrated by the sketches in fig. 5 (*a*), (*b*) and (*c*), showing the average current flowing in the circuit to be constant at 5 amperes under normal conditions, but in the case of (*d*) an unbalance is created across R_a and consequently across R_v, the current increases, and therefore the average of (*c*) and (*d*) is higher than that of (*b*) and (*c*). It will now be appreciated that any increase of current flowing from the battery B_1, which is the source of supply, bears a direct relation to the intensity of the incoming signals, as also does any decrease of current in the anode circuit of V_2, assuming that the frequency of the incoming signal is constant.

Mr. A. H. Midgeley's low-current resistance amplifier probably operates in a similar manner.

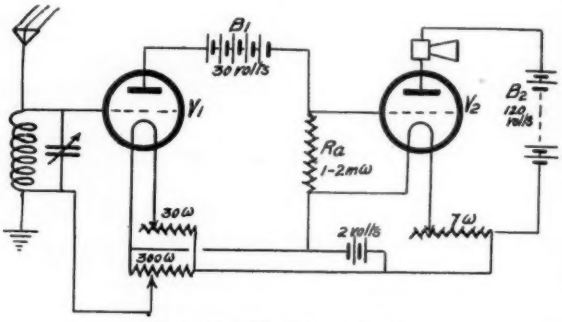


Fig. 4.—Simplified 2-Valve Circuit.

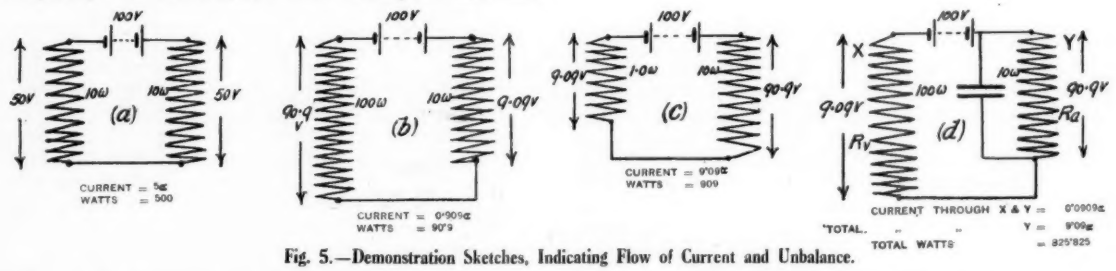


Fig. 5.—Demonstration Sketches, Indicating Flow of Current and Unbalance.

Moullin Voltmeter Application.

What is perhaps a more important function of this circuit is its use as a form of Moullin voltmeter for the direct measurement of constant high- or low-frequency potentials, allowance for frequency being made by suitable adjustment of the time-constant of the condenser C and resistance R_a.

The arrangement shown in fig. 6 has been found extremely useful for making comparative tests of field-strength, losses in coils, condensers, and aerials, &c. The method of operation is to adjust the reading on the milli-ammeter in the anode circuit of V_2 by means of the counter-bias battery B_2 to a known maximum point situated on the straight portion of the grid voltage-plate current characteristic curve of the valve concerned, the input terminals being connected to the circuit under test. It is obvious that comparative reductions of milli-ammeter readings may be taken, and it is tentatively suggested that such apparatus could be properly calibrated for a large range of frequencies. To give some idea of the sensitivity of this apparatus, it may be said that changes of from $3\frac{1}{2}$ to $4\frac{1}{2}$ milliamps. are obtainable with a moderately good aerial circuit, off the carrier wave of 2LO at from eight to ten miles distance.

Situations Vacant.

The Lure of an Occasional Change of Scene.

[Communicated.]

ONE of the minor attractions of the trade Press is recognised by certain engineering firms in the careful removal of the Situations Vacant advertisements from every journal before it is allowed to circulate to the different departments for perusal. There is in this practice a tacit acknowledgment of the fact that by the energetic and ambitious an increase in remuneration can often be more readily secured by a timely change of situation than from an existing employer. In this matter the personal interest of employer and worker are often at variance under present conditions. The normal business needs a permanent and contented body of workers, and especially a staff which is not subject to too-frequent changes. It is not until a man has occupied a post for some nine or twelve months that he really begins to work with the maximum of efficiency. The first few months, though they may furnish some very hard going to the worker, are by no means the most profitable to the employer. It is by the end of the first year that the value of the services rendered grows steadily, but unfortunately, at the present time, this is a fact which is too often disregarded, and the financial reward by no means keeps pace with increased efficiency. It is a truism that it is often easier for a worker to increase his remuneration by 100 per cent. by a change of position than it is to secure an additional 5 per cent. from the existing one, and while this state of things is a feature of the policy in many British works, it is only to be expected that many of the more ambitious workers are sometimes tempted to work more with an eye upon the possibilities of the next situation than with a single-minded devotion to the existing one.

On the other hand, this tendency has of late years been much modified in the case of the more mature and responsible class, and the difficult situation created by the housing shortage is often sufficient reason for an established worker to remain a fixture in spite of all the disadvantages. The immobility of labour is by no means confined either to the skilled tradesmen of the engineering industry or the lower grades, but extends to the higher executive posts. Local changes are usually impossible in small and medium-sized towns, as there is usually an understanding between the different engineering undertakings of a district that they will not take men from neighbouring works. But whatever may be the reasons in favour of continuing permanently in the same employment in the case of the mature worker, a younger man, and especially the time-expired apprentice, cannot afford to settle down in the works where he has received his training, and such a one should devote herculanean efforts, if necessary, to the task of finding a fresh opening in the shortest time possible, so as to enlarge his experience at a time when it is most needed and at a period of his career when it can be obtained with a minimum of inconvenience. There are some works which make it a settled policy to turn off all time-expired apprentices, whether of the wage-earning or the premium-paying variety, twelve months after the expiration of their articles, and though the policy may be regarded as a hardship at the time, it is undoubtedly in the youngsters' ultimate interest.

Instances may, of course, be adduced of steady promotion which has come to certain fortunate individuals who have spent their whole life with the same organisation. Such advancement speaks more highly for the capabilities and the character of the worker than is generally supposed; but in most of these cases it is reasonable to infer that an even greater measure of success and a wider utility would have resulted from one or two judicious changes. As showing some of the minor drawbacks which attend a too-prolonged stay in one place, the writer found that one director of a large engineering works who had risen from the ranks of the establishment was still addressed by the majority of the staff by his christian name without any prefix, a practice which had persisted from the youthful days of his first appearance.

It is one of the dangers of a lengthy stay that familiarity begets a certain measure—if not of contempt—at least of under-estimation! Though everyone would in theory subscribe to the policy and the evident justice of advancing existing workers when opportunity presents itself, in actual practice there are few firms which do not prefer to engage an outsider when there is a position of importance open, or when work of any special difficulty has to be done. In the case of an outside man, there is nothing known to his disadvantage; his capabilities are likewise largely unknown, and for that very reason are apt at first to be over-estimated, although in actual fact they may be much inferior to what is already available without going outside the four walls of the organisation. The practice is also partly due to the supposition that by obtaining an outside man the benefits are obtained of experience and experiments at someone else's expense.

Though a change in the sphere of activity may offer a valuable financial prize, it will not be secured without hard and unremitting work, nor without a careful study and application of the principles of salesmanship as applied to such an intangible commodity as personal service. From the fact that a very junior opening or modest position in the electrical or engineering field will often bring in a number of applications running into three figures, it is safe to estimate beforehand that a proportion of several hundred unsuccessful to one successful application will be a normal rather than a specially discouraging experience. In this connection it is useful to remember that the number of openings in a particular trade may really be smaller than the "Wanted" advertisements might imply. There is occasionally reason to suppose that some of the advertisers who hide their identity modestly behind a box number, and who insist so strongly upon the fact that "no application will be considered which does not give in the first instance the fullest possible particulars, both of previous results obtained and exact details of past experience," may often be more desirous of securing information regarding the working of a rival business than the additional help which is the apparent object of the advertisement. Even in an interview, such leading questions as "What profit do you put on the Indian oil-engine business?" "What business have you succeeded in doing in the Argentine?" or "How did you arrive at such consumption figures as quoted for the —— job?" will be familiar to many readers, and they are apt to raise uncomfortable doubts respecting the genuineness of the post as well as suspicions of the general policy of the undertaking which will attempt to secure its information in this way.

Survey of the National Coal Resources.

The Lancashire and Cheshire Survey Committee, the first to be appointed by the Department of Scientific and Industrial Research, in conjunction with the Lancashire and Cheshire Coal Research Association, has recently been enlarged in order that it may be representative of the whole coalfield. Its chairman is Mr. R. A. Burrows. Five other committees are also actively at work.

The New Hire-Purchase Bill.

An Outline of the Effect of Prospective Legislation.

By W. ERIC JACKSON, LL.B., Barrister-at-Law.

THE short and apparently insignificant Hire-Purchase Bill now before Parliament makes a long-wished-for and very necessary alteration in the law relating to hire-purchase dealings. The Bill at first sight seems simple enough and contains very few words. Its effect may be summed up in a line or two. Goods which are out on hire-purchase and which remain the property of the person selling them on hire-purchase terms are not to be liable to distress for rent, nor are they to be seizable by the trustee in bankruptcy. Such is the effect of the Bill, and many traders will doubtless be led into the belief that the Bill will confer upon dealers of goods that long awaited security which they have desired.

But dealers must not build too much upon the Bill. In many instances the new hire-purchase measure will have no effect at all. It is only in those cases where the terms of the hire-purchase agreement are such that the ownership of the goods remains in the dealer until the completion of the instalments that the new Bill will have any effect.

Up to the present many devices have been employed to retain in the dealer the legal ownership of the goods. An express clause that the ownership is to remain the dealer's is not always effective. It was pointed out by the Courts some years ago that the vital distinction between those cases where the ownership remains in the dealer and those cases where it is transferred immediately to the buyer, is the presence in the hire-purchase agreement of a clause stating that the buyer is to be entitled at any time to return the goods and be under no further liability.

When the buyer can return the goods in this way it is quite obvious that the agreement is one of hiring and not one of purchase. In those instances where the buyer is merely bound to pay instalments, on the payment of the last of which he becomes owner, he is not a hirer, but is a person who has agreed to buy. Hence, by the terms of the Sale of Goods Act he has a limited ownership, and perhaps a complete legal title to the goods.

The new Bill only covers those cases in which the goods are not the hirer's property; that is, where the goods remain the dealer's through the presence in the agreement of some clause such as is mentioned above. Dealers would be therefore well recommended to have their agreements overhauled by some competent solicitor so as to ensure that if and when the Bill passes it will give them the intended protection.

The need for the Bill will be readily appreciated from the fact that the Law of Distress (Amendment) Act, 1908, expressly exposed hire-purchase goods to seizure by the landlord. In no case was the dealer able to evade or escape the consequences of a landlord's distress. This of course imposed a considerable risk upon a dealer and rendered it necessary that he should obtain the fullest information as to the hirer's financial position before letting the goods go out.

As regards bankruptcy, there has hitherto been no way in which dealers have been able to avoid seizure by the trustee. Hire-purchase goods are generally held to be in the hirer's reputed ownership with the consent of the true owner. Many forms of agreement have been suggested as a mode of avoiding this. One popular form states that as soon as a hirer presents a petition or has a petition presented against him, the owner's consent shall be deemed to be withdrawn. The goods then not being in the debtor's possession with the owner's consent would not be in the reputed ownership of the debtor; but the weakness of the scheme is that on the presentation of the petition it is too late for the owner to withdraw his consent.

Hence, goods held by a debtor on hire-purchase have been in nearly every case seized by the trustee in bankruptcy, and all that the dealer has been able to do is to prove his claim like an ordinary creditor and obtain a dividend on the outstanding instalments.

If the new Bill passes, however, all this will be made clear. The owner of hired goods will be secure, provided always that his hire-purchase agreement is a hiring and purchasing agreement in the full legal sense and is not an agreement for sale with payment by instalments. In order to be a proper hire-purchase agreement there must be a clause, as mentioned above, permitting the hirer to return the goods at any time and to put an end to the agreement and to be under no further liability.

The Design of Condenser Bushings.

A Method of Rapid Calculation which takes into Account the more Important Practical Data.

A QUICK method of designing condenser bushings which takes into account the most important practical data has been devised by Prof. A. Imhof, of Winterthur, consulting engineer to Micafil, Ltd. The method, which was originally published in the *Bulletin* of the Swiss Society of Electrical Engineers, 1926, No. 12, has been developed for uniform axial and radial potential gradients, assuming infinitely thin layers and also finite thicknesses; the design for uniform axial stress with the use of layers of unequal thickness has also been worked out. We are indebted to the *Bulletin* for the following particulars, which should make it possible to obtain very rapidly the required form for the bushing, taking as a basis the points of greatest importance in practice. The rapidity with which the calculation can be made and an idea of the nature of the result obtained is of considerable importance in this case, as a number of influences (length of mounting, diameter of conductor, tangential and radial stresses) have to be investigated to obtain the best arrangement and dimensions.

Here and there one finds engineers who regard condenser terminals with misgivings. Control of the potential gradient by means of conducting layers is, however, undoubtedly necessary with the high voltages now used, and experience is continuously showing the high-voltage engineer that it is only by such careful control that waste of material can be avoided and many designs are made possible. Great advances have been made in the manufacture of hard paper, and the dielectric losses have been greatly reduced; it is now possible to make hard paper bushings for the highest voltages, *e.g.*, figs. 1 and 2 show bushings made by Micafil, Ltd., for 150 and 220 kV. In both of them the very thick-walled body of hard paper is subdivided into smaller cylinders by a process developed by the author, and corona at the mounting is prevented almost up to the flash-over voltage. If the upper portion is covered with porcelain, as in fig. 3, the terminal is suitable for outdoor use.

The ratio of the maximum to the minimum radial field strength is called the *coefficient of radial variation* u_r, and similarly the ratio of the maximum to the minimum axial field strength is called the *coefficient of axial variation* u_a.

1. Design for Equal Axial and Radial Potential Gradient.

This assumption allows of great clearness in designing, and also leads to suitable dimensions from a manufacturing point of view. If all the layers are made of the same thickness, then, in order to satisfy the condition that the axial and radial potential gradients shall be equal, the lengths of successive layers must vary in arithmetical progression, *so that the line passing through the edges of the conducting layers is straight.* The diameter of the terminal and the lengths of all the layers of foil can be obtained immediately, according to the mean

Fig. 1. 150-kV condenser bushing.

Fig. 2. 220-kV condenser bushing.

Fig. 3. 87-kV outdoor type bushing.

Figs. 1, 2 and 3.—High-voltage "Micafil" Hard-paper Bushings.

radial and axial stress chosen, and the diameter of the conductor and the length of the mounting. At the same time, attention must be paid to the condition that the coefficient of variation $u = u_r = u_l$ must be as small as possible; this limits the choice of conductor diameter and length of mounting. When it is remembered that the dielectric losses in Bakelite paper vary with the square of the field strength, the importance of uniform radial stress becomes evident. With a coefficient of variation of 1.8, the losses in the layers under

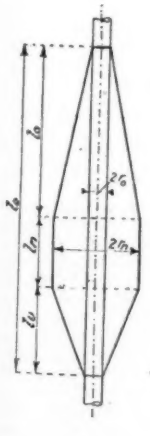


Fig. 4.

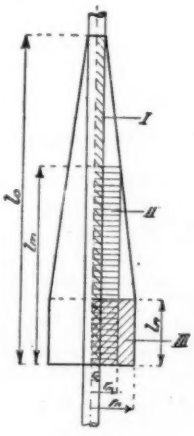


Fig. 5.

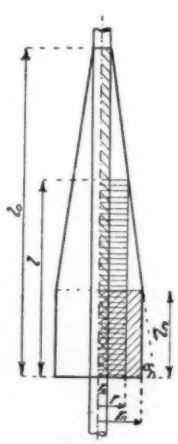


Fig. 6.

greatest stress are $1.8^2 = 3.24$ times as high as in the layers under least stress. The minimum variation obtains, caeteris paribus, *when the inner and outer layers are stressed equally and the middle layer is stressed least.* This condition must, therefore, be satisfied as nearly as possible in all designs.

(a) Design Assuming Infinitely Thin Layers.

This approximation, which can usually be applied with sufficient accuracy for *layers of finite thickness*, leads to very simple relations which can be employed to some extent in method (*b*) below.

In order that the stress shall be symmetrical, *i.e.*, that the stresses in the outer and inner layers shall be equal, the capacities must be equal; or (fig. 4)—

$$2 r_o \pi l_o/d = 2 r_n \pi l_n/d, \text{ so that}$$

$$r_o = l_n r_n/l_o \qquad (1)$$

r_o = radius of conductor; r_n = radius of mounting; l_o = length of inner laying of foil; l_n = length of mounting, or length of outer earthed layer of metal; d = thickness of the very thin layers.

The following lettering is also introduced:—

V_p = testing voltage; H_r = mean radial field strength; H_l = mean axial field strength at part of terminal in air; H_u = mean axial field strength at part of terminal in oil. Thus, from equation (1)—

$$r_o = l_n (r_o + V_p/H_r) / \left\{ l_n + V_p (1/H_l + 1/H_u) \right\},$$

which can be reduced to—

$$r_o = l_n/H_r \, (1/H_l + 1/H_u). \qquad (2)$$

From the equation the radius of the conductor can be determined after choosing an imaginary (mean) value for the radial and axial stress. It is interesting to note that the ratio l_n/r *is independent of the voltage and is only a function of the stress chosen.* If the coefficient of variation may not exceed a certain value, then r_o and l_n must not be chosen too small. The following points must be considered in the calculation of the coefficient of variation: The capacity of a thin cylindrical layer, when all layers are of equal thickness, is proportional to the length and radius of the cylinder. If the length is regarded as analogous to "force" and the radius as the distance from a fulcrum, then the capacity is equivalent to "moment" M. Fig. 5 shows a terminal with the lower part cut off perpendicular to the axis, and the length of the upper part increased by the length of the lower part removed. The capacities, or moments, for the individual layers are then readily obtainable as rectangles.

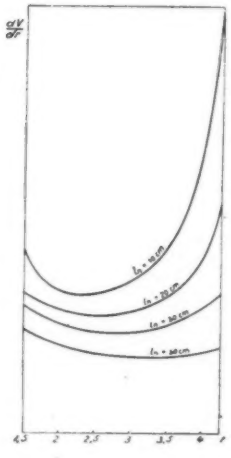


Fig. 7.

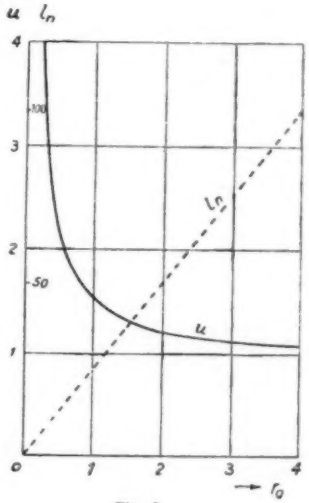


Fig. 8.

For *symmetrical stress*, this is a minimum in the centre layer of radius r_m, and a maximum in the outer layer of radius r_n or the inner layer of radius r_o—

$$r_m = \tfrac{1}{2}(r_o + r_n); \; l_m = \tfrac{1}{2}(l_o + l_n); \; M_n = r_n l_n;$$

$$M_m = r_m l_m = \tfrac{1}{4}(r_o + r_n)(l_o + l_n).$$

$$u = M_m/M_n = (r_o + r_n)(l_o + l_n)/4 r_n l_n \qquad (3)$$

r_n and l_n can be substituted for by introducing the testing voltage V_p and the field strengths, H_r, H_l and H_u, leading to the equation—

$$u = (2 r_o H_r + V_p)^2/4 r_o H_r (r_o H_r + V_p). \qquad (4)$$

When $r_o = \infty$, $u = 1$. Equation (4) shows *that u is independent of the axial field strength.*

If the stress is not symmetrical, the radius r for which M is a maximum is given by (fig. 6)—

$$r = \tfrac{1}{2}(r_n l_o - r_o l_n)/(l_o - l_n). \qquad (5)$$

The area of the rectangle of this radius is divided by the rectangle I or II, fig. 5, whichever is the smaller, to obtain u.

To obtain the layers, the radius is divided into small parts as required, preferably equal. The thickness of the layers is of importance, inasmuch as the axial and radial potential gradients in the region of the edges of the layers of foil are dependent upon it.

(b) Design Assuming Layers of Finite Thickness.

This method of calculation is used chiefly when the total thickness is divided into only a few layers. In this case also, however, it is advisable at first to check rapidly with equation

(2) to see that the ratio l_o/r_o is suitable, and with equation (3) to see that u lies within the desired limits.

It is also assumed that the dielectric resistance of the inner layer is equal to that of the outer.

Let n=number of layers, l_n length of mounting, r_o radius of conductor, r radius of mounting.

For a hollow cylinder the dielectric resistance is the reciprocal of the capacity :—

$$R = 2/D l \,.\, \log (r_x/r_{x-1}) = 1/l_1 \,.\, \log (r_1/r_0) = 1/l_n \,.\, \log\ r_n/r_{n-1})$$

where l=length of cylinder, Dl=difference in length between two conducting layers and $l_l = l_n + (n-1)Dl$. Inserting these values we obtain length of mounting—

$$l_n = (n-1)\, D l \log (r_n/r_{n-1})/\log (r_1/r_0 \,.\, r_{n-1}/r_n) \qquad (6)$$

For this length of mounting the stress in the outer layer is equal to that in the inner, and u is the minimum for the chosen diameter of conductor.

In (6) $r_n = {}_{e^x}+ V_p/H_r$, where V_p =testing voltage, and H_r = values we obtain length of mounting—

$$u = \frac{R\ \text{max.}}{R\ \text{min.}} = \frac{\log\ (r_1/r_0)}{\log\ (r_m + \frac{1}{2}d)/(r_m - \frac{1}{2}d)} \,.\, \frac{l_n + \frac{1}{2}(n-1)\,Dl}{l_n + (n-1)\,Dl} \qquad (7)$$

where d=thickness of a layer, and $r_m = r_o + \frac{1}{2}(r_n - r_o)$.

Putting the logarithmic portion of equation (6)=a, and eliminating l_n in equation (7) :—

$$u = \frac{2a+1}{2a+2} \,.\, \frac{\log\ (r_1/r_0)}{\log\ (r_m + \frac{1}{2}d)(r_m - \frac{1}{2}d)} \qquad (8)$$

If the electric stress is not distributed symmetrically about the middle layer, the length of the mounting must be altered. Increasing the length has the effect of reducing the stress in the outer layers, and reducing it increases the stress; u becomes greater and increases as the stress on the terminal gets less symmetrical. The layer with minimum stress is no

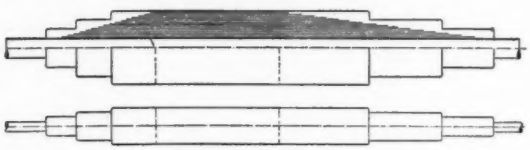


Fig. 9.

longer at the centre, but nearer the part of the terminal with smaller stress. To find u, the dielectric resistances of the layers with maximum and minimum stresses are determined; these are easily found from the foregoing.

In fig. 7 the field strength is shown as a function of the radius of the terminal for various lengths of mounting; these differ from the most suitable values as calculated above to illustrate the importance of correct dimensioning. The ordinate scales for the four terminals are different, so as to keep the curves well apart from each other for clearness. If the scales were the same, the areas below the curves would be equal.

Fig. 8 shows u for a 64-kV terminal as a function of the radius of the conductor, assuming in each case the most suitable of all the possible lengths of mounting. The length of mounting is also indicated. In practice it is often impossible to choose the most suitable dimensions, but an approximation is always possible.

Example for method b :—

It is required to find the dimensions for a 150-kV bushing, assuming the following stresses :—

H_r=45 kV/cm.; H_l=2.9 kV/cm.; H_u=6.0 kV/cm.

Testing voltage (S.E.V. Standards) $V_p = 2\times150+10=310$ kV.

Diam. chosen for conductor: 2 r_o=5.0 cm.; thickness of layer=0.4 cm.

Thickness of hard paper=310/45=6.9 cm. No. of layers=69/4, say 17. Length of upper part (in air)=310/2.9=107 cm.; length of step=107/17=6.3 cm.; length of lower part (in oil) =310/6=51 cm.; length of step=51/17=3 cm.; n=17; $n-1$=16; r_n=2.5+6.8=9.3 cm.; r_{n-1}=9.3−0.4 =8.9 cm.; r_o=2.5 cm.; r_1=2.5+0.4=2.9 cm.; Dl=6.3+3.0=9.3 cm.

Length of mounting by equation (6) l_n=62.8 cm.

a=0.422.

r_m=3.4+2.5=5.9 cm.

Coefficient of variation u=1.43.

Fig 9 shows the terminal thus calculated (no dimensions are given); for clearness, the upper figure is drawn with the diametral scale twice the axial scale. The lower figure shows the true proportions.

2. Design for Uniform Axial Stress, Using Layers of Different Thicknesses.

This method gives the smallest dimensions, with either layers of unequal thickness and steps of equal length, or layers of equal thickness and steps of varying length. In practice it is preferable to have steps of equal length. Each layer has the same dielectric resistance, and the potential drop across each layer is the same. The thinnest, and hence the most highly stressed, layers are the inner and outer ones. The coefficient of variation is a minimum when the inner and outer layers are equally stressed.

Let x_o = radius of conductor
x_1 = radius of first (inner) layer of foil
x_2 = radius of second layer of foil
x_n = radius of nth layer of foil (*i.e.*, of mounting)
l_1 = length of inner layer
l_n = length of outer layer (*i.e.*, of mounting)
c = a constant.

The dielectric resistance of all layers must be equal; this is the case when

$$x_n/x_o = e^{cl} \,;\; c = (\log x_n - \log x_o)/l = \tan a$$

whe e $l = (l_1 + l_n)n/2 = \Sigma_1^n\, l_n$.

Logarithmic paper (fig. 10), with uniformly divided abscissæ and logarithmic ordinates, is now required.

Σl is marked off along the x axis :

$\Sigma_1 l = l_1$; $\Sigma_2 l = l_1 + l_2$; $\Sigma_3 l = l_1 + l_2 + l_3$; &c.

On the ordinate through x_o (to the logarithmic scale) and the ordinate through $\Sigma_n l = l_1 + l_2 + \ .\ .\ .\ + l_n$ the radius x_n of the mounting is plotted; the straight line passing through the points thus obtained represents equation (9).

The values x_n can be read off directly on the ordinates. Logarithmic paper with as large a scale as possible should be used. The length l_n of the mounting must be calculated from equation (2), n being chosen so that the middle layer is of the desired thickness (3 to 4 mm.).

A terminal designed by this method to suit the same conditions as the terminal shown in fig. 9 has approximately the same appearance.

By this method the coefficient of radial variation u is given very readily; u = maximum thickness of layer/minimum thick-

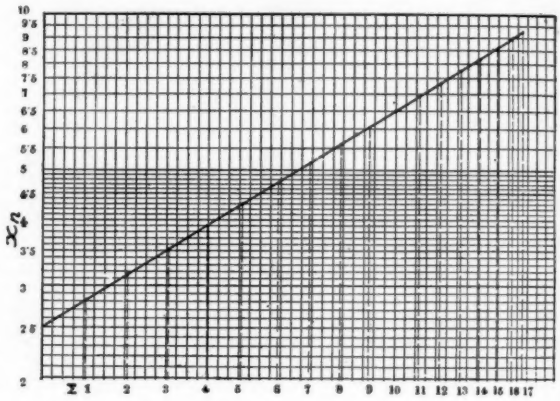


Fig. 10.

ness of layer. The minimum coefficient of variation can be adjusted by displacing the lines $x_o - x_n$ until the inner and outer layers are of equal thickness.

The axial potential gradient on the outer surface no longer agrees exactly with the one found by calculation, as the conducting layers are not usually continued to the outer surface.

Other factors influencing the potential gradient on the outer surface are the line passing through the edges of the conducting layers, and the form of the mounting and head plate. A good idea of the influence of these factors may be obtained by constructing diagrams of the lines of force in the manner used by Kuhlmann* for bushings without control of the gradient in the dielectric. General rules can be obtained from these for making suitable corrections to the layers.

* Archiv fuer Elektrotechnik, Vol. VI, 1915, Sections 8-9.

"The Service of Electricity."

An address on the above-named subject was delivered by Mr. Alexander Lindsay, M.I.E.E., J.P., before the Glasgow Publicity Club on December 2nd. The speaker said that the use of electricity would clarify the atmosphere and allow the health-giving rays of the sun to penetrate. Of the 10,000,000 homes in this country, 7,000,000 were situated in areas supplied with electricity, but only 1¼ million houses were wired for the purpose. In Glasgow only some 28,000 houses, or approximately 14 per cent., were so fitted. The only thing which would prevent electricity from becoming cheaper was insufficient demand.

In a discussion which followed, Mr. R. B. Mitchell, city electrical engineer, stated that the whole change-over to 50 cycles of the city system was expected to be finished in five years from the beginning of 1929. The appliances generally would require no alteration, but if any change were needed the supply authority would make it without any cost to the consumer. Regarding charges, he said it was impossible to institute a penny per kWh all-round charge at the present time. Electricity was cheap to those who were liberal users, and the man who used only a little had no right to it at a penny per kWh.

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments, Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations and Failures.

The Christmas Holidays.

Owing to the Christmas Holidays it will be necessary for the issue of the ELECTRICAL REVIEW for December 23rd to appear one day earlier than usual, and for that of December 30th to be published one day later than usual.

Our contributors to all editorial sections are asked to bear these alterations in mind, especially in the case of December 23rd issue. All matter must be in our hands very promptly for that REVIEW.

We would direct the attention of advertisers and all who are responsible for the preparation of advertising copy, to the notice appearing in our advertising pages to-day, in which the latest times for the receipt of matter and blocks for December 23rd and 30th issues are stated.

The E.D.A. Circle Campaign.

The British Electrical Development Association's "last word" on National Electric Week, which closes to-morrow (Saturday) showed that 650 shop windows at least were exhibiting the special display; nearly a quarter of a million copies of the "Open Letter" had been circulated; and, in addition, many Circles and undertakings were organising other special publicity, competitions and social activities.

We have received the official catalogue of an electrical exhibition organised by the Boston and District Circle; the show was opened by the Mayor on December 6th, and it closes to-morrow (Saturday). The exhibition is arranged as an electric home, comprising a dining room, drawing room, bedroom, bathroom and kitchen. Each apartment was furnished by local firms, and in addition there are four stands arranged to show modern shop-window lighting and others arranged by Volta, Ltd., Hoover, Ltd., L. G. Hawkins and Co., Ltd., and British Insulated Cables, Ltd. In this way the many domestic and commercial uses of electricity are admirably demonstrated. Painting and essay and slogan competitions for children have been organised in connection with the exhibition. Apparatus was lent for the show by a number of the leading electrical manufacturers.

The "Underground" Suggestion Scheme.

The staff suggestion scheme which was instituted by the "Underground" group of companies ten years ago has proved very fruitful of results. Many thousands of suggestions have been put forward, and a large proportion of these have been adopted. During October last 614 suggestions were put forward by members of the staff, and in 68 cases awards were made. An electrical fitter at the Acton works has received six awards during the past year, and has accordingly been granted a special bonus in addition to the individual awards. The suggestions cover every department of the companies' business, including power house, track, stations, trains, omnibuses, &c.

The Rhodesian Electrical Market.

The *British and South African Export Gazette* says that one of the most interesting developments in Rhodesia in recent years has been the rapid and widespread movement towards the electrification of the mines. Actually last year's imports of electrical plant for the mines were double those of the previous year; the total value was £41,493, and the indications are that the rate of progress is being maintained. The electrical imports generally of Rhodesia have increased most in miscellaneous plant, batteries, and wires and cables.

B.C. Railway Employés' Claim Fails.

As the result of an arbitration it is announced that the conductors and motormen of the British Columbia Electric Railway Co., Ltd., are not to receive the increase of about 10 per cent. in wages for which they recently applied. The recently-terminated agreement will probably be renewed and remain in force, with minor changes, for a period of three years.

Glasgow and the E.D.A.

After hearing a letter from the director and secretary of the British Electrical Development Association, at a recent meeting, asking the Corporation to continue membership of the Association and to make a contribution to the funds for the year 1927, the Glasgow Electricity Committee adhered to its previous decision to make no contribution to the funds of the Association.

Contractors and Hire-Purchase.

In the course of a discussion upon one of the papers read at the Convention of the Electrical Contractors' Association at Scarborough in June, Mr. R. Robson referred to the continued expansion of the hire-purchase system. He said that most contractors were not in a position to finance the system; they would have to place the business in the hands of finance organisations. The E.C.A. was considering the matter, and perhaps might eventually provide a financing organisation. An account in the *Electrical Contractor* of the last meeting of the Council of the Association contained the following statement from the report of the chairman of the Trading Committee:—"*Hire Purchase.*—Progress has been made with the proposed formation of the new company, and at the next meeting of the Trading Committee instructions will be given to inaugurate this."

Unemployment.

There was a small increase (560) in the number of unemployed during the week ended November 21st. At that date the total was 1,126,300, as compared with 1,125,740 on November 14th and 1,514,730 on November 22nd, 1926 (coal dispute period).

Recent Contracts.

Amongst recent orders, Messrs. Davey, Paxman & Co., Ltd., have received the following for their heavy oil Diesel engines: The War Office, for the supply of electric generating sets complete to Chatham and Jamaica; Thames Sand Dredging Co., Ltd., engine for electrical and plant use; and the Alloa Shipbreaking Co., Ltd., 466/535-b.h.p. engine for driving an alternator in Rosyth Dockyard.

Among recent orders received by B. E. N. PATENTS, LTD., for "B. E. N.-Myers" car-washing plants are:—A 4-gun plant for the *Evening Standard*, and three 4-gun plants for the Edinburgh Corporation Tramways.

All-British Exhibition in Australia.

A meeting of representative citizens was held in Melbourne last month with the object of furthering interest in the All-British Trade Exhibition which is to be held under the auspices of the Australian Association of British Manufacturers in the Melbourne Exhibition Building from February 23rd to April 10th next. The Lord Mayor presided, and those present included Sir Lennon Raws, a former President of the Australian Associated Chambers of Commerce, Sir James Barrett, and Sir Aaron Danks. Sir Adrian Knox, the Commonwealth Chief Justice, who is President of the Association, read out a comprehensive list of British manufacturers who have already contracted for positions in the exhibition. The Victorian Government has promised its assistance. It is intended that the event should be a forerunner to the Sydney Exihibition proposed to be held in 1931.—*Reuter* (Melbourne).

Social Events.

The Blackpool Corporation Electricity and Tramways Employés' Institute held its annual whist drive and dance last week. Twelve hundred persons played whist, and 2,000 took part in the dance which followed. The Mayor and Mayoress presented the prizes.

The annual whist drive and dance of the staff of the Paisley Electricity Department and their friends was held at the Town Hall on November 25th. The company included many representatives of electrical manufacturers and contractors. Mrs. W. L. Winning, Glasgow, presented the prizes.

Exhibitors at the Birmingham Fair.

In addition to the firms detailed in our last issue, the following are participating in the electrical section of next year's British Industries Fair, Birmingham:—

Donovan & Co., Birmingham.
Moffats, Ltd., Weston, Ont., Canada.

Canadian Copper Mine Development.

The Harry Payne Whitney interests in New York have exercised their option on the Flinflon Mine, Northern Manitoba, which they entered into a year ago with the Mining Corporation of Canada. According to the London *Evening News*, the deal involves an expenditure of £10,000,000, including the construction of a railway to the mine from the Hudson Bay line, the erection of a smelter to cost £2,400,000, and the development of hydro-electric power at Whitemud Falls, Nelson River.

Christmas Tree Lighting.

The GENERAL ELECTRIC CO., LTD., is drawing traders' attention to the special Christmas tree lighting equipment which it supplies. In addition to the sets of 9 or 18 lamps (depending upon the voltage of supply) for plugging into a lampholder, the company also provides outfits for use in shops which have no electricity supply. These consist of sets of flashlamps connected in parallel for operation off 6- or 12-V accumulator batteries. The 6-V set is capable of running for 10 hours from a 20-Ah battery.

Cast-Iron Pipe Developments.

The *Financial Times* states that authentic news has been received in London of the successful issue of negotiations between Prof. Gottsberger, President of the Centrifugal Cast Iron Pipe Company, and the large French cast iron pipe interests. It is understood that the arrangement come to completes the chain of cast iron pipe manufacturers using the centrifugal process throughout the world. The licensees in America are the United States Cast Iron Pipe Company; in England the Stanton Iron Works; and in Germany the Gelsenkirchener Company, now a part of the Stahlverein. "This international ring represents a capital of at least £30,000,000, and is regarded as a very important step in the regularisation of cast iron pipe prices throughout the world." The managing director of the Stanton Ironworks Co., Ltd., has written to the Press "emphatically to deny any suggestion of any financial arrangement in regard to capital, or in regard to selling prices, with producers either at home or abroad."

Irish Free State Electrical Imports.

The imports of electrical goods, excluding machinery, into the Irish Free State during October last were valued at £30,581, as compared with £45,967 in the corresponding month of 1926. The aggregate imports during the first ten months of the year are officially returned at £310,470, as compared with £373,564 in the similar period of the preceding year, a decrease of £63,184.

Trade Announcements.

The TRUMAN ELECTRICAL CO. has opened a new branch at 12, Walsall Road, Cannock ('Phone 204), with electrical showrooms.

Messrs. LESLIE DIXON & CO., 218, Upper Thames Street, E.C.4, inform us that they are taking over the British agency for the "Asymmeter" which was described in our issue of November 25th (p. 913).

Messrs. T. S. MARRIAGE & CO., electricians, have sold their premises in Station Road, Redhill, and the whole business will be centralised at the premises at Reigate.

Mr. A. WILSON, electrical and wireless engineer, has opened new premises at 277, High Street, Lincoln.

MESSRS. CECIL HODGES & CO., LTD., have removed to new works at Salfords, Surrey. Telephone: Horley 400; telegrams: "Ammeter, Horley." Address for goods: Horley Station, Southern Railway.

New Catalogues and Lists.

MESSRS. PHILLIPS & TURNER, Cambridge Street, Birmingham.—A leaflet illustrating examples of the firm's brass cable saddles and clips.

THE SUN ELECTRICAL CO., LTD., 118-120, Charing Cross Road, W.C.2.—A list of revised prices and terms for the company's catalogue No. 458. The revisions cover cables, ironclad switch- and fuse-gear, tumbler switches and other electrical accessories.

THE WESTMINSTER ELECTRICAL CO., 2, Tanswell Street, Lambeth, S.E.1.—A trade price list of electrical materials and accessories and radio sundries.

MESSRS. JOHN SHAW & SONS, WOLVERHAMPTON, LTD., Wolverhampton.—A pamphlet illustrating the "Owl" watch stand and night light. Priced.

THE MERSEY CABLE WORKS, LTD., Linacre Lane, Bootle, Liverpool.—List No. 12, containing specifications and prices of rubber-insulated cables and flexibles.

THE HART ACCUMULATOR CO., LTD., Stratford, E.15.—No. 8 of a series of mailing cards addressed to battery dealers.

BURNDEPT WIRELESS, LTD., Blackheath, S.E.3.—Works Publication No. 130, containing instructions and diagrams for the building of battery chargers, eliminators, &c., with "Burndept" parts.

THE CONSOLIDATED PNEUMATIC TOOL CO., LTD., 170, Piccadilly, W.1.—A series of illustrated publications dealing with portable electric tools, portable air compressors and pneumatic plant.

ST. HELENS CABLE & RUBBER CO., LTD., Slough.—An illustrated and priced catalogue of the company's products, including cables, wires, wiring system, insulating materials, wood casing, &c. The publication is provided with a thumb index and includes some useful tables. Also a separate price list of v.i.r. lead-covered cables.

THE WET H.T. BATTERY CO., 12-13, Brownlow Street, High Holborn, W.C.1.—An illustrated and priced booklet dealing with "Standard" sac Leclanché h.t. and l.t. batteries for radio work.

THE BRITISH WOOD IMPREGNATING CO., LTD., 30, Norfolk Street, Strand, W.C.2.—A booklet describing the "Cobra" process of impregnating telegraph, telephone, transmission-line and other poles and wooden structures.

THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—A series of illustrated publications describing the company's oil-immersed rotor starters, time-limit fuses, d.c. high-speed circuit breakers and motor convertors.

HOLLAND HOUSE ELECTRICAL CO., LTD., 247a, St. Vincent Street, Glasgow.—Price lists of lampholders of various patterns, conduits and accessories, and wiring sundries.

MESSRS. MAVOR & COULSON, LTD., 47, Broad Street, Mile End, Glasgow.—A calendar-blotter advertising the company's "G" size chain coal cutter.

THE SOLENOID REGULATOR CO., 268, Moseley Road, Birmingham.—An illustrated and priced catalogue of shunt and series regulators.

MESSRS. JAMES MCMILLAN & CO., Clun House, 17, Surrey Street Strand, W.C.2.—An illustrated pamphlet describing the "Rex" combined electric cooking range and coke stove. Priced.

THE BRITISH THOMSON-HOUSTON CO., LTD., Crown House, Aldwych, W.C.2.—A handsome booklet, illustrated in colour, fully describing the "RK" loud speaker, and d.c. mains unit and amplifier. Also a coloured folder containing particulars, performance curves and prices of the company's new nickel-filament valves.

BRITISH INSULATED CABLES, LTD., Prescot, Lancs.—Catalogue P.219 (replacing P.155), containing illustrated particulars of overhead equipment for tramways and light railways.

PHILIPS LAMPS, LTD., 145, Charing Cross Road, W.C.2.—An illustrated descriptive booklet dealing with the company's battery charging devices and h.t. supply units for radio sets Priced.

MESSRS. PETTERS, LTD., Westland Works, Yeovil.—"Petter's Monthly News" for November, containing illustrated articles and notes upon the company's products, &c.

Bankruptcy Proceedings.

F. A. WILLIAMS, 96, Churchill Road, Great Yarmouth, electrician.—The public examination of this debtor was held recently at the Town Hall, Great Yarmouth. The statement of affairs showed liabilities of £375, and there was a deficiency of £316. Debtor stated that he became aware of his position in June last, but incurred further liabilities in the hope of getting business in the autumn and winter. In 1926 he was ill, which had contributed to his present position, and he had not had sufficient capital. The examination was closed.

R. H. NICHOLSON, trading as W. Nicholson, 8a, High Street, Mexborough, Yorkshire, decorator and electrician.—The public examination of this debtor was held on December 1st at the County Court Hall, Sheffield. The statement of affairs showed liabilities of £1,555, against assets of £77, leaving a deficiency of £1,477. After a statement by the debtor, the examination was closed.

MAX NEWTON, trading as M. Newton & Co., incandescent and electric lighting merchant, 3, Oakwood Avenue, Roundhay Road, Leeds.—The public examination of this debtor was held recently at the Court House, Leeds.—The liabilities expected to rank for dividend amounted to £1,815, and there was a deficiency of £1,800. Debtor attributed his failure to bad trade and lack of capital. The examination was adjourned for the production of further accounts.

J. GLICKMAN (Manchester Radio Service Co.), wireless factor, 10, 12 and 14, Great Ducie Street, Manchester.—Last day for proofs for dividend, December 13th. Trustee, Mr. A. T. Eaves, 47, Mosley Street, Manchester.

G. BLADES, electrical engineer, 55, Hainton Avenue, and 52, Pasture Street, Great Grimsby.—First and final dividend of 9¾d. in the £, payable at the Official Receiver's office, St. Mary's Chambers, Great Grimsby.

A. F. WEBB, electrician, late of 102, Duke Street, St. Helens, Lancs.—First and final dividend of 3s. 4¼d. in the £, payable at the offices of the Official Receiver, 11, Dale Street, Liverpool.

F. RIPPINGILLE, agent for electrical fittings, Winchester House, Victoria Square, Birmingham.—Application for discharge to be heard January 12th, at the Court House, Birmingham.

H. WILSON, electrical contractor and decorator, 1057, Grangefield Avenue, Thornbury, Bradford.—Last day for proofs for dividend December 16th. Trustee, Mr. J. O. Morris, Official Receiver, 12, Duke Street, Bradford.

Company Liquidations.

ENDWELL ELECTRIC CO., LTD.—A meeting of creditors is called for December 14th at the office of the liquidator, Mr. K. H. Mitchell, College Hill Chambers, 23, College Hill, E.C.

MIDLAND WIRELESS MANUFACTURING AND SUPPLY CO., LTD.—A meeting of members is called for January 3rd at 17, Albion Street, Hanley, to hear an account of the winding up from the liquidator, Mr. R. E. Clark.

ORLING'S TELEGRAPH INSTRUMENTS SYNDICATE, LTD.—A meeting of members is called for December 30th at 15, Grosvenor Mansions, 82, Victoria Street, S.W.1, to hear an account of the winding up from the liquidator, Mr. H. Hagon.

Calendar.

MESSRS. SINCLAIR, PAGET & CO., LTD., Shoreditch, E.C.2, have sent us their 1928 calendar, consisting of boldly-figured monthly sheets.

Electric Power in Industry.

Preliminary Report No. 29 upon the 1924 Census of Industry (*Board of Trade Journal*, December 1st), shows that in the flock and rag trades there was 700 kW of electric generating plant and 7,313 h.p. of electric motors, power for 6,722 h.p. of which was purchased. The woollen and worsted trades reported 73,716 kW of generating plant (against 34,045 kW in 1912). There were also 78,075 h.p. of electric motors (power for 11,966 h.p. purchased), as compared with 30,907 h.p. in 1912. In the clothing and millinery trades there was 3,026 kW of generating plant and 29,983 h.p. of motors (power for 28,210 h.p. purchased). The fur trade reported no generating plant, but it had 1,544 h.p. of electric motors.

United States Foreign Electrical Trade.

The statistics of United States foreign trade during September last show a decline in the exports of electrical goods as compared with September, 1926; the total was $8,233,537 against $9,430,066. There was, however, an increase of $94,296 as compared with August. The principal decline occurred in rectifiers, motor-generators, convertors, &c., which fell in value from $352,136 to $82,812. Other large decreases were :—A.c. generators (over 2,000 kVA) from $226,121 to $84,769; railway electric locomotives from $349,505 to $190,172; railway motors from $205,652 to $63,213; motors between 1 and 200 h.p. from $311,267 to $201,813; radio receiving sets from $351,994 to $246,239; unspecified apparatus from $686,543 to $446,913; bare copper wire from $265,335 to $111,332; and insulated copper wire and cable from $504,754 to $361,115. Domestic apparatus, generally speaking, remained at about the same level. There was a very large increase in exports of switchboard panels (except telephone), from $100,262 to $420,532, and unspecified telephone equipment also rose from $166,556 to $280,191; apart from these there were no outstanding increases. A market analysis shows that the most important customer was Canada, whose share was valued at $1,977,350. Other large importers of American goods were: Brazil ($800,602), Japan ($667,537), Argentina ($492,929), Australia ($472,131), and the United Kingdom ($459,640).

The electrical imports of the United States during September were valued at $260,316, electric lamps being the principal item. Japan supplied goods to the value of $108,316, Germany's share was $94,476, while Great Britain provided goods valued at only $11,132.

Book Notices.

Scientific Papers of the U.S.A. Bureau of Standards. No. 560. "Density and Electrical Properties of the System Rubber-Sulphur" (15 cents). No. 561, "Co-operative Measurements of Radio Fading in 1925" (15 cents).

Publications of the Technical Section of the Association of Engineering and Shipbuilding Draughtsmen.—"Steel Works Buildings," by A. G. Swift. Price 3s. 6d. "Cranes; Leading Particulars and Information of Various Types," by F. J. Wiggle. The general applications and features of electric cranes and lifting apparatus are outlined. Price 2s.

"*Mechanical World* Year Book, 1928." Pp. 348, fully illustrated. Manchester: Emmott & Co., Ltd. Price 1s. 6d. net.—A feature of the new edition of this handbook is a section on "Epicyclic or Planetary Gearing." Another new section comprises B.E.S.A. tables of limits and fits in engineering. The other work generally has been brought up to date, some parts being entirely rewritten.

We have received a copy of the December number of the *Siemens Magazine*, the journal of the employés of Messrs. Siemens Bros. & Co., Ltd., of Woolwich. An article on the organ, sports club notes, Christmas articles, some pictures of the works, and many personal staff notes, are contained in this issue.

"Physics in Industry," by H. E. Wimperis and F. C. Smith. Vol. V. Pp. 53; figs. 7. London: Humphrey Milford, Oxford University Press. Price 2s. 6d. net.

Copper Conductor Tables.

BRITISH INSULATED CABLES, LTD., has published (at 5s.) tables containing very full data regarding stranded circular annealed plain copper conductors and stranded h.d. copper conductors for overhead lines.

The Leipzig Fair.

Forty-eight British firms participated in this year's International Industries Fair at Leipzig. Among them were Callender's Cable & Construction Co., Ltd., and Neutron (1927), Ltd.

For Sale.

H.M. Office of Works invites offers for several motor-generators, distribution boards, motors, cable, electric lamps, &c., lying at Wembley. (See our advertisement pages to-day.)

Local Exhibition.

An electrical exhibition is being held by Spalding Urban District Council at Ayscoughfee Hall. The Pirelli-General Cable Works, Ltd., recently gave a dinner to the members of the Council to mark the completion of the electricity scheme, after which the company visited the exhibition.

Italian Foreign Electrical Trade.

Commerce Reports publishes statistics of Italy's foreign electrical trade, showing that during the first six months of this year the total value of imports was 112,744,684 lire, against 137,719,780 lire in January-June, 1926. The largest item was telegraph and telephone apparatus (32,470,549 lire), and generators and motors were imported to a large extent (21,097,975 lire). Germany was the principal supplier of the most important classes of goods. During the first half of this year Italy's exports of electrical goods were valued at 29,598,126 lire, as compared with 27,714,690 lire in the corresponding period of 1926. The chief item was generators and motors (15,824,129 lire), and the principal customers were France (2,047 quintals out of a total of 11,789 quintals) and British India (2,023 quintals).

Recognition of Long Service.

As a means of showing their appreciation of men and women who have been in their service for 25 years, the directors of the Chloride Electrical Storage Co., Ltd., have recently instituted a special certificate. This is well printed in colours and gold on stout cartridge paper, with simple, appropriate wording. Accompanying each certificate is the handsome present of £100.

Correction.

We regret that in last week's advertisement of the Pomona Rubber Co., by a printer's error, the name "Superbalite" was incorrectly given as "Superpalite."

Prices of Raw Materials.

Reporting on December 3rd, Messrs. James Eorster & Co. stated :—"With a continuation of the present firm conditions in London and in New York, it seems almost certain that higher values for lead will be seen before long, while, should the Australian shipping lock-out continue, a serious position might easily arise here, though, fortunately, stocks are large.

Messrs. F. Smith & Co. report, December 6th :—Copper (electrolytic) bars, £66 5s., 25s. inc.; ditto ditto sheets, no change; ditto ditto wire rods, £76 5s., 25s.; ditto ditto h.c. wire, 9 9/16d., 1/16d. inc.

Messrs. James & Shakespeare report, December 6th :—Copper bars (best selected), sheet and rod, £90, £2 inc.; English pig lead, £23 15s., 10s. to 15s. inc.

Messrs. Edward Till & Co. report, December 6th :—No change in the price of India-rubber, Para fine.

Lighting and Power Notes.

Audenshaw.—STREET LIGHTING.—Having received alternative estimates from the Manchester Corporation Electricity Department for lighting the main roads, the Urban District Council has appointed a committee to report on the question.

Bedford.—LOANS.—The Corporation Electricity Committee is applying for sanction to a loan of £20,000 for mains extensions

Sanction has been received to the borrowing of £10,000 for meters and £8,000 for the purchase of domestic apparatus to be let out on hire.

Birmingham.—ELECTRICAL DEVELOPMENT.—In order that the Electric Supply Department may meet the continued growth in the demand for electricity supplies, it has become necessary to raise further capital. In a report to the City Council the Electricity Committee points out that applications for electricity supplies are being received every week in such numbers as to indicate the continued popularity of electricity, both for industrial and domestic purposes. In addition to the requirements for general extensions of distributing mains, provision is to be made for the cost of large trunk mains from the new station at Hams Hall to various distribution centres in the city. The detailed estimates indicate that £804,000 will be required to meet the cost of these works for a period of 18 months to the end of March, 1929. This amount is made up as follows: Trunk feeders from Hams Hall, £233,000; general extensions of feeders, e.h.p. mains and l.p. distributors, £561,000; and e.h.p. trunk mains, £10,000. In addition, the Committee asks for authority to expenditure in connection with the consequential development of the sub-station system. This includes the scheme for establishing centres at which electricity will be delivered in bulk from the new station, transformed and distributed to consumers. This estimated expenditure is £143,000, and a further outlay of £145,000 for additions to the sub-station system is recommended. This equipment will provide for new e.h.p. consumers' supplies. The total expenditure proposed is £1,092,000. The Finance Committee has raised no objection to the proposals and points out that the annual loan charges will amount to approximately £79,264, and will be met out of the revenue of the undertaking.

Bolsover.—INAUGURATION OF SUPPLY.—The Urban District Council's electricity scheme was recently formally inaugurated by the chairman of the Council. Electricity is supplied by the Staveley Coal and Iron Company, and it is hoped to extend the scheme in the New Year to Shuttlewood and Carr Vale.

Cardiff.—ELECTRICITY CHARGES.—In the accounts for the December quarter, the Corporation will introduce the following reduced charges for electricity:—Lighting: 4d. per kWh; maximum demand system, 4d. and 1½d. per kWh; late shop window lighting, 2d. per kWh. Cooking: ½d. per kWh. Heating and other domestic appliances: Summer quarters, ½d. per kWh; winter quarters, 1d. per kWh. Where cookers are installed, the charge for other domestic appliances is ½d. per kWh all the year round. Power: 1½d. per kWh; maximum demand system, 1½d. and 7/16d. per kWh; also reductions in bulk supply tariffs. The Corporation has also introduced an "all-in" tariff of 12½ per cent. of the rateable value, plus ½d. per kWh for electricity consumed for all purposes.

Continental.—GERMANY.—Arrangements have been concluded whereby the power stations in the Rhine district of both Germany and Switzerland are to be linked up in order to give an increased supply of electricity to the States of Baden and Wurtemburg.

SWEDEN.—The Director General of the Waterfalls Board states that the consumption of electric power in Sweden indicates a slow but steady increase in the activity of most industries. The largest increase in consumption has taken place in the cellulose and the Lapland ore-mining industries. The consumption of electricity for household and agricultural purposes is also increasing. No immediate important new construction of hydro-electric power stations is planned, but the Waterfalls Board has asked for a Budget allowance of Kr. 2,000,000 for the next financial year in order to increase the production of electrical energy.—*Reuter's Trade Service* (Stockholm).

Dover.—ELECTRICITY SUPPLY.—At a recent meeting of the Corporation Electricity Committee it was stated that in various streets in different parts of the town there were over 1,800 houses not lighted by electricity, and it was suggested that it might prove remunerative to extend mains in these streets by the overhead system and carry out free wiring and install slot meters. The electrical engineer was asked to prepare a report on the matter.

The committee has called for a further report with regard to the supply of electricity to Whitfield. The electrical engineer stated that the scheme would not be remunerative, but it was suggested that the proposal might prove successful if an additional charge of 1d. per kWh were made.

Epsom.—LOAN SANCTIONED.—The Urban District Council has received sanction to a loan of £3,000 for electricity meters.

Falkirk.—ELECTRICITY IN BULK.—In view of the terms quoted by the Scottish Central Electric Power Co. for a bulk supply, the Town Council has agreed to ask the Electricity Commission to sanction the borrowing of £21,000 to enable it to install the necessary plant to meet requirements.

Guildford.—ELECTRICITY IN BULK.—The Corporation Electricity Committee has voted a sum of £2,500 in connection with proposals for affording a bulk supply of electricity for industrial purposes to Messrs. Drummond Bros., Ltd.

The committee has received a letter from the London and Home Counties Joint Electricity Authority stating that it had had under consideration an inquiry from Edmundson's Electricity Corporation, Ltd., as to a bulk supply in the near future for the company's Dorking undertaking, and inquiring if the Corporation could offer the required supply. The matter has been referred to the consulting engineer and the electrical engineer for consideration.

The Horsham Urban District Council has informed the Corporation that the Electricity Commissioners have requested the Council to inquire as to the possibility of a bulk supply to Horsham from the Guildford station, the terms of such a supply, and the probable date. The matter is to be discussed with the representatives of the Horsham Council.

LOAN SANCTIONED.—The Electricity Committee has received sanction to a loan of £1,300 for the erection of buildings at the central sub-station in Onslow Street.

Guisborough.—ELECTRICITY SUPPLY.—The Rural District Council has passed a resolution authorising the Cleveland and Durham County Electric Power Co. to supply electricity within its area.

Halifax.—YEAR'S WORKING.—We have received the statement of accounts of the electricity undertaking for the year ended March 31st last. The total revenue amounted to £217,577, as compared with £182,467 in the preceding year. The cost of fuel increased from £19,717 to £50,725, with a consequent increase in working expenses from £98,292 to £130,079, the gross profit being £87,499, as against £84,175, to which was added interest on investments, making a total of £91,824 available. After payment of capital charges, there was a net surplus of £20,843, as compared with £23,854 in 1925-26. A sum of £8,654 was contributed to the borough fund. The capital expenditure during the year amounted to £90,745, the chief items being £51,561 for mains and services, and £23,608 for switchgear. The sales of electrical energy increased from 25,385,352 to 25,906,213 kWh, and the maximum supply demanded from 13,800 to 14,100 kW.

Hendon.—BREAKDOWN.—Owing to the flooding of two of the sub-stations of the Hendon Electricity Supply Co., due to the heavy rainfall, the electric lighting supply failed at Mill Hill and part of Hendon on November 29th. The station in Mill Hill broadway is built over a sewer, and the water burst through the drain and flooded the station to a depth of nearly 3 ft. The other station, near Edgware Road, was flooded by the overflow of a brook, the water round the transformers rising to a height of 4 ft.

Hull.—SUPPLY TO HOUSING ESTATE.—The Corporation Works and Electricity Committees are to discuss the question of the lighting by electricity of another 400 houses on the western housing estate.

Irish Free State.—ELECTRICAL DEVELOPMENT.—Arrangements are now being made for the supply of electricity from the Dublin Corporation electricity works to the Electricity Supply Board for the purpose of the electrification of the south-eastern area of the Free State, pending the coming into operation of the Shannon scheme. The Leinster counties, and some of the Munster counties will be served under this scheme, and it is expected that the supply from Dublin will be available as far as Waterford by February next.

Good progress has been made in the electrical engineering and the civil engineering sections of the Shannon scheme. The No. 4 loop, for the Leinster and Munster areas of Waterford, Wexford, Kilkenny to Dublin, has now been completed. All the standards and cables have been erected. The erection of the sixteen transformer stations is in progress. The building of the transformer station at Waterford is now approaching completion. The work of the installation of the electrical equipment in the transformer stations will be proceeded with soon. For the 110-kV main line from Limerick to Dublin, poles have been erected as far as Athy from the Dublin end. The Waterford to Cork line is practically completed. The standards on the line from Waterford to Limerick have been erected as far as Limerick Railway Junction.

Kingussie.—ELECTRICITY SUPPLY.—The differences which had developed between the Town Council and the electricity users on one side, and the Grampian Electricity Supply Co. on the other have been satisfactorily settled, and an unrestricted service will be available for the town by the end of February. An agreement had been signed whereby the company undertook for a period of fifteen years the lighting of the streets at £4 per lamp per annum, the lighting to be between sunset and 11 p.m., and private consumers could participate in the supply only during the same hours. As the result of negotiations, however, an unrestricted supply to private consumers is now assured.

Leicester.—NEW MAIN.—The Corporation Electricity Committee has decided to lay a main from the central power station to a proposed sub-station at Sanvey Gate at a cost of £7,700.

Llandudno.—SUPPLY TO RAILWAY STATION.—The Urban District Council has offered to supply electricity to the L.M.S. Railway Company for the lighting of the railway station at 3d. per kWh for a minimum of 13,000 kWh annually, the cable to be laid free of cost to the company.

STREET LIGHTING.—The Council has adopted a report of the Electricity Committee for the improvement of street lighting in Mostyn Street, the Promenade, and streets leading to the Promenade. On the Promenade the 100-W lamps are to be replaced by 200-W lamps for next season, the entire length of the Promenade. Provision is to be made for the shelters to be lighted with coloured lights, and for fixing coloured lights and reflectors to the existing lamp standards.

Maidstone.—LOAN SANCTIONED.—The Town Council has received sanction to a loan of £30,000 for mains.

Morecambe.—ELECTRICITY SUPPLY.—At a recent meeting of the Corporation Electricity Committee the electrical engineer reported upon the position of the negotiations with the L.M.S. Railway Co. for a supply of electricity for traction purposes and lighting and power at Heysham Docks, and submitted a scheme to the Committee, with estimates of the cost of the provision of the supply. The scheme is to be submitted to the Electricity Commissioners for approval.

Newton-Stewart.—ELECTRICITY SCHEME.—A circular issued regarding the electricity scheme for the town states that the Dalbeattie Electric Power Co. will supply electricity for lighting at from 10d. to 1s. per kWh. This will mean a reduction in the charge for lighting to consumers as compared with the prices now ruling for gas lighting. Electricity, it is stated, will be generated by water power.

Nuneaton.—ELECTRICAL DEVELOPMENT.—At a meeting of the Town Council on November 30th, the Electricity Committee reported that it had considered the details of a scheme submitted by the engineer for changing over one of the outlying districts from d.c. to a.c. supply, and for giving a supply to two large power consumers. This would necessitate the erection and equipment of three additional transformer kiosk substations, additional switchgear at three existing sub-stations, and h.p. interconnecting cables between three sub-stations. The Committee recommended that application be made for sanction to a loan of £8,000, the estimated cost of carrying out the work. The recommendation was approved.

Rainford (Lancs.).—ELECTRICITY SCHEME.—In connection with the Urban District Council's agreement with the St. Helens Corporation for the supply of electricity to the district, the following terms have been arranged:—Long-hour consumers (theatres, &c.), 5.434d. per kWh; short-hour consumers (cottage lights), 6.986d. per kWh; power purposes (mills, works, &c.), 3.105d. for first 100 kWh per month, and

1.553d. above this amount; heating and cooking, 1.15d. per kWh; motor rent, 2s. 6d. per annum. The Council has received a Fringe Order for the supply of electricity to the Rainford Potteries at Mill Lane.

Special Orders.—The Electricity Commissioners have submitted to the Minister of Transport for confirmation Special Orders made by them authorising the Wisbech Electric Light and Power Co., Ltd., to supply electricity in part of the urban district of Walsoken; the Amesbury Electric Light and General Supply Co., Ltd., to supply in the parish of Amesbury; the North Metropolitan Electric Power Supply Co., to supply electricity in certain parishes in the rural district of Epping; Mr. F. H. Grace to supply in part of the rural district of Thornbury; the Power Development Co., Ltd., to supply electricity in the borough of Romsey, the rural districts of Romsey and New Forest, and part of the rural district of Lymington; and the Electricity Distribution of North Wales and District, Ltd., in the urban district of Buckley.

Stoke-on-Trent.—SUPPLY TO HOUSING ESTATE.—The Corporation is considering the lighting by electricity of the Collison Square housing estate, Goldenhill, at an estimated cost of £4,000.

MAINS EXTENSIONS.—The Electricity Committee has authorised mains extensions at a cost of £2,200.

Thornton-Cleveleys.—ELECTRICITY CHARGES.—In the proposed amalgamation between Thornton-Cleveleys and Blackpool it is provided that the prices for electricity are to be 10 per cent. over those operating in Blackpool for 10 years, and then to be uniform with Blackpool.

York.—LOAN SANCTIONED.—The Corporation has received sanction to a loan of £27,833 for new boiler house plant.

Tramway and Railway Notes.

Blackburn.—PROPOSED TRANSPORT BOARD.—The Town Council, on December 1st, adopted a resolution convening a conference of North-East Lancashire local authorities with the idea of forming a tramway and transport board for the running of through services between neighbouring towns. It was decided to invite Rawtenstall, Burnley, Accrington, Darwen, Bolton, Chorley, Wigan, and Preston to be represented at this conference. Ald. Higham mentioned that the question of co-ordination had been under the consideration of Lancashire and Cheshire tramway authorities for two or three years, but through-running arrangements could not be secured without admitting the large 'bus companies into the scheme. The Municipal Tramways Association had been trying for some years to get a Bill through Parliament giving local authorities who owned tramways powers also to run motor omnibuses. This would have to be taken as a private member's measure.

Continental.—SWEDEN.—In addition to the recently-completed electrification of the Stockholm-Gothenburg Railway and the previously electrified Riksgraensbanan (The National Frontier Railway), the northernmost electrified line of its kind in the world, the State railways of Sweden are now utilising electricity for other purposes. The Railroad Administration has announced that 1,300 of its railway passenger cars are now equipped with electric heating apparatus. A.c. at 1,000 V is used for this purpose, and the State Railways Department has found the new system both economical and efficient. The Department has also received a new kind of electric locomotive, at present being used for shunting work in the Central Station of Stockholm. These engines are driven by electric power furnished by accumulators, have a capacity of 150 h.p., and have so far given most satisfactory results. Larger engines will probably be ordered later on from "Asea," the leading electrical works of Sweden. The manufacturers have recently started the manufacture of electric automobile trucks with accumulator batteries and an effective carrying capacity of about 3½ tons. These new wagons have proved excellent in use, and will be manufactured on a comparatively large scale.

SWITZERLAND.—The work of electrifying the Richterswil-Sargens-Buch section of the Swiss Federal railways is now practically completed, and an electric train service is to be commenced on December 15th.

The Federal Railway authorities in Berne have drawn up a new programme for the electrification of further sections of the Swiss railway system. During the course of the next few years it is proposed to electrify a further 262 miles, at an estimated cost of £1,140,000.

London.—METROPOLITAN ELECTRIC TRAMWAYS.—A number of tramcars of the Metropolitan Electric Tramways, Ltd., have recently been fitted with the latest type of light-weight, high-speed motors, with the satisfactory result that the running time of cars in the North-West London district has been reduced by as much as 15 per cent. This reduction has been effected, not by increasing the actual speed of the car, but by providing better acceleration and braking. A tramcar fitted with the new motors can now attain the official maximum speed of 20 m.p.h. in 15 seconds. The cars are fitted with magnetic brakes. The number of cars fitted with the new motors now totals 50. It is claimed that the highest average speed of any surface stage carriage vehicle in Europe has now been achieved by the company.

Manchester.—PROPOSED UNDERGROUND RAILWAY.—According to *The Times*, a Committee of the City Council has prepared a report on the proposal to construct a tube railway for the city and district. The scheme includes an inner circle under the central thoroughfares of the city 2.64 miles long and costing over £2,000,000. Five additional radial lines are suggested serving the suburbs of Withington and Didsbury, Levenshulme, Openshaw, with eventual extension to Audenshaw and Droylsden, Newton Heath, with extension to Failsworth and Oldham, and Cheetham Hill and Prestwich. The total length of these lines would be 16.36 miles underground, and the initial cost £10,954,540. The population served would be 949,000. The city engineer is quoted, in the report of the committee, as of the opinion that neither at the present time nor in the future would it pay to construct a branch radial line off the inner circle owing to the expense of construction, but the inner circle would require the revenue from the radial routes to support it. The scheme, in his opinion, is financially impossible.

Telegraph and Telephone Notes.

Australia.—AUTOMATIC TELEPHONY.—Plans for the conversion of the whole of the Commonwealth's city telephones from the manual to the automatic exchange system, and for an extension of trunk-line services in all States, have been completed. In making this announcement, the acting Director of Postal Services (Mr. G. G. Haldane) said the cost was estimated at £3,000,000, and the programme was set out to cover a period of five years. Within that period 53 new automatic exchanges, serving 111,782 subscribers, would be opened in the Commonwealth; most of them would be conversions of manual exchanges, but a few would be additional to the number of exchanges already in existence. The principal additions to the trunk-line services would be on the lines between the capital cities, but there would be extensions to many parts of the country. Rural automatic exchanges, such as had been installed in a number of small towns in Victoria and New South Wales recently, would be established in numerous other towns throughout Australia.

Cable Telegraphy.—RADIO "BEAM" COMPETITION.—With further reference to our recent note on the above subject, it is understood that the fall in revenue of the cable companies due to the growing use of wireless telegraphy has become so serious that negotiations are now proceeding between the Government and the telegraph cable companies. The matter is referred to editorially elsewhere in this issue.

Replying in the Australian House of Representatives on December 5th to a question, Mr. S. M. Bruce, Prime Minister, stated that the position of the cable service since the development of the "beam" service was serious, and was becoming acute; it would be more so should the "beam" service advance in the next twelve months at the same rate as during the first two. It was proposed to appoint a committee of representatives of the Governments concerned to meet in Great Britain to discuss the question.—*Reuter* (Canberra).

Transatlantic Telephony.—AMERICO-CONTINENTAL SERVICES.—Telephone conversation between New York and Stockholm, Sweden, was inaugurated on November 29th by Count Adolf Hamiltonm, delegate to the recent Radio Conference, and is expected to be the beginning of a regular telephone service to Sweden. Similar services have been established to Antwerp and Brussels, but calls to Paris have been difficult owing to the poor land wires.—*Reuter* (New York).

International Telephony.—LONDON-VIENNA SERVICE.—A direct telephone service between London (England) and Vienna (Austria) was inaugurated on December 1st.

OSLO-PARIS SERVICE.—Telephone communication between Oslo and Paris was inaugurated on December 1st by messages between the Press of the two capitals. The results were very satisfactory.—*Reuter* (Paris).

Irish Free State.—TELEGRAPH LINE ALTERATIONS.—It is understood that it is contemplated to discontinue the direct telegraph line from London to Waterford, and that in future cross-Channel messages will be relaid *via* Limerick, Cork, or Dublin. It is understood to be a question of the upkeep of the cable between Rosslare (Wexford) and Fishguard (Wales); the direct line will only continue henceforth to and from Waterford up to 4 o'clock in the afternoon, and messages between London and Waterford after that hour will be sent by the longer indirect route.

The Telephone Service.—"TOLL" AREA EXTENDED.—Hitherto communicated with by trunk calls, the following six towns were on December 3rd brought within the London "toll" telephone exchange area:—Southend, Leigh-on-Sea, Aldershot, Camberley, Horsham, and Chatham.

Radio Notes.

Daventry Experimental Station.—NEW AERIAL.—The new aerial promised when "Daventry Junior" started work in August is now up, and engineers are testing the signal strength, but the new aerial will not be put in regular use at once. Recently 5GB's power was increased by 6 kilowatts to a total of about 24 kilowatts.

Research Station Fire.—PLANT DESTROYED.—The Government Radio Research Board's laboratory, test room, apparatus, and a 200-ft. high lattice aerial mast at Ditton Park, near Slough, Buckinghamshire, were destroyed by fire on December 1st.

United States.—INTERNATIONAL BROADCASTING.—The National Broadcasting Co. has notified the Federal Radio Commission that it intends to endeavour to establish systematic international broadcasting at the earliest possible date. The first interchange of programmes is planned between the United States and England, and in the United States it is intended to operate between the hours of 7 and 11 in the evening, e.s.t., throughout the year. Experience has shown that two short wave-lengths at least will be required to enable British reception of American programmes. The transmitter will deliver approximately 20 kilowatts of power, modulated telephonically, and will be installed at Bound Brook, N.J., in the same building as the present broadcast transmitter of WJZ. The programmes will not be broadcast to the public, but addressed to the British Broadcasting Corporation's corresponding receiving station in England, and regarded as a point-to-point service. It is possible that commercial arrangements relative thereto will be worked out and, in any case, the programme will not be available for rebroadcasting purposes, except by those to whom it is addressed. According to *World-Radio*, the purpose of this restriction is to make certain that the rebroadcasting shall be conducted by responsible agents capable of giving good service to the public abroad, and in such efficient manner that a fair idea of the nature and quality of American programmes can be gained by the public in foreign countries. The two wavelengths desired for the purpose are 27.207 metres (11,020 kilocycles) and 18,715 metres (16,020 kilocycles). The first is within a band already assigned for relay broadcasting, and the second within a point-to-point service band.

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Argentina.—BUENOS AIRES.—January 17th. National Sanitation Works Department. Three 350-kW Pelton-type turbines and 6,600-V, three-phase generators. Two 20-kVA 3-phase static transformers, one distribution switchboard and connections. (B.X. 3921.)*

Australia. — MELBOURNE. — January 3rd. Postmaster-General's Department. Switchboard lamps, lamp caps, and lamp sockets. (B.X. 3943.)*

January 23rd. State Electricity Commission of Victoria. 6,600-V automatic induction voltage regulators. (B.X. 3972.)*

January 31st. Sub-station protectors, mountings, fuses and heat coils for telephone exchanges. (B.X. 4019.)*

SYDNEY.—February 1st. New South Wales Government Railways. One 3,000-kW rotary-convertor unit for Hornsby sub-station, one ditto for St. Leonards sub-station. Chief Electrical Engineer, 61, Hunter Street, Sydney.

January 9th. Municipal Council. 11,000-V metal-clad switchgear for sub-stations. Construction Engineer, Electricity Department, Town Hall, Sydney.

Hemsworth.—December 13th. West Riding Education Committee. Electric lighting installation at new school and caretaker's house, Four Lane Ends. Education Department, County Hall, Wakefield.

Blackpool.—December 15th. Electricity Committee. One 1,750-kW convertor for traction supply. (November 11th.)

Dewsbury.—December 12th. Corporation. Pumps, motors, and other electrical plant for the Ravensthorpe sewage works. Specification (£2 2s.) from the borough engineer, Mr. H. Dearden.

Edinburgh.—December 19th. District Board of Control. Electrical work for two residential blocks at Gogarburn. Schedules, &c., from Mr. S. Kaye, 14, Hill Street, Edinburgh.

Egypt.—CAIRO.—December 14th. Egyptian State Railways, Telegraphs and Telephones. Chief Inspecting Engineer, Queen Anne's Chambers, Broadway, Westminster, S.W.1. Telegraph and telephone material (approx. £E9,800 to £E10,100).

High Wycombe.—December 15th. Church Council. Electric lighting installation, &c., Hazlemere Church. (December 2nd.)

Leicester.—January 21st. Electricity Department. Buildings, coal- and ash-handling plant, railway sidings, &c., three water-tube boilers complete, one 25,000-kW and one 1,500-kW turbo-alternators with condensing plant and accessories, and three ferro-concrete cooling towers. (December 2nd.)

London.—CENTRAL ELECTRICITY BOARD.—December 22nd. 132,000-V transformers for the Central Scotland Electricity Scheme, 1927. (November 11th.)

BETHNAL GREEN.—December 29th. Board of Guardians. Electric passenger lift, &c., at the Institution, Waterloo House, Bethnal Green, E. (December 2nd.)

Lourenco Marques.—February 13th. Ports and Railways. Two 350-h.p. electric motors. (B.X. 3996.)*

Manchester.—December 12th. Electricity Committee. Electric kettles. (December 2nd.)

December 23rd. Electricity Committee. Electric wash boilers. (See this issue.)

January 3rd. Low-pressure auxiliary pipework. (See this issue.)

December 13th. Tramways Committee. Magnetic track brakes for tramcars. Specification from Mr. H. Mattinson, general manager and chief engineer, 55, Piccadilly, Manchester.

New Zealand.—WELLINGTON.—January 10th, 1928. Public Works Department. Additional 110,000-V switchgear, steelwork and control board for Arapuni electric power supply. (B.X. 3837.)*

January 17th. 110,000-V switchgear protective apparatus, steelwork, storage batteries, &c., for the Waikaremoana power scheme. (B.X. 3858.)* 50,000-V switchgear and steel work for Arapuni. (B.X. 3917.)* 11,000-V switchgear and metering equipment for Arapuni (Sec. 254). (B.X. 3920.)*

January 24th. 11,000-V switchgear and metering equipment for Arapuni (Sec. 261). (B.X. 3918.)* February 18th. Storage battery and motor for Arapuni. (B.X. 4032.)*

CHRISTCHURCH.—March 13th. Drainage Board. Nine electric centrifugal sewage pumping plants. (A.X. 5457.)*

Preston. — December 14th. Electricity Committee. 32,000 tons of fuel for Ribble power station, Penwortham, required during the year ending December 31st, 1928. Specification from Mr. J. F. Simpson, borough electrical engineer, 118, Fishergate.

Rhyl.—December 17th. Electricity Department. 3,400 yd. e.h.p. cable, e.h.p. switchgear, two 250-kVA static transformers, l.p. switchgear, 880 yd. armoured cable. (November 25th.)

South Africa.—JOHANNESBURG.—January 3rd. Municipal Council. 32 transformers. (B.X. 3991.)* Electric lamps and holders. (B.X. 4042.)*

December 29th. S.A. Railways and Harbours. One 5-ton 3-motor electric overhead travelling crane for East London workshops. (A.X. 5506.)*

Stafford.—December 31st. Education Committee. Installation of electric lighting and power in the Friary School, Lichfield. (See this issue.)

Tilbury.—December 14th. Electricity Department. Two 250-kW transformers and two h.p. switch cubicles. (November 25th.)

Uruguay.—MONTEVIDEO.—January 21st. State Electricity Works. Overhead sub-stations and switching towers. (B.X. 4028.)*

February 5th. Ministry of Public Works. 22 cranes for the Hydrographic Department. (A.X. 5478.)*

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Cumberland.—
Electric lighting and power installation at the central premises of the Egremont Industrial Co-operative Society, Ltd.—T. S. Bell & Co. (Whitehaven).

Dudley.—Works Committee. Recommended :—
Master clock for new town hall (£225).—Synchronome Co., Ltd.

Fareham.—Rural Council. Accepted:—
Electric lighting installation for new Council houses being erected at Titchfield.—Portsmouth Corporation Electricity Department.

India.—BOMBAY.—Corporation Standing Committee. Accepted :—
Renewals for electric sewage pumping plant (Rs. 6,488).—Worthington Simpson, Ltd.

Leeds.—Electricity Committee.
Equipment for first instalment of boiler house for the new Kirkstall generating station (£202,114) : three Stirling boilers, economisers, air heaters, dust extractors, and all conveying plant.—International Combustion Co., Ltd.

Lincoln.—
Wiring and complete electrical equipment of the new premises for "Leonora," 187, High Street.—G. R. Howard.

London.—LONDON COUNTY COUNCIL. Education Committee :—
Wiring Janet Street school, Poplar, for electric lighting and power :—

Smethurst & Co. (London), Ltd. (Recommended.)	**£390**
T. Clarke & Co., Ltd.	430
G. A. Weston	441
Ellis & Ward, Ltd.	497

Wiring and fittings for electric lighting, power, bells and telephone at Grammar School, St. Marylebone :—

Alpha Mfg. & Electrical Co., Ltd. (Recommended.)	**£1,152**
Griggs & Son	1,159
H. J. Cash & Co., Ltd.	1,236
Coleby & Co.	1,256
J. Briggs, Electrical Contractors, Ltd. ...	1,277
Barlow Bros. & Co.	1,430
Pinching & Walton	1,479
Heath-Pritchard, Ltd.	1,485

Reigate.—Town Council. Accepted:—
Extension of the contract for wiring houses under the hire-purchase scheme for another year.—T. S. Marriage & Co.

Salford.—Electricity Committee. Accepted:—
7,000 yd. l.p. cable and 500 yd. e.h.p. ditto (£1,701).—N. V. Nederlandsche Kabelfabriek.
500-kW rectifier equipment, complete (£2,937).—Hewittic Electric Co., Ltd.

Trowbridge and Melksham.—Board of Guardians. Accepted :—
Rewiring electric bells in the casual wards, &c.—Edwards & Armstrong.

Forthcoming Events.

Physical Society.—Friday, December 9th. Imperial College of Science, South Kensington, S.W. 5 p.m. Ordinary scientific meeting.

Institution of Mechanical Engineers.—Friday, December 9th. Storey's Gate, S.W. 7 p.m. Informal meeting. "Economics in Engineering." Major S. J. Thompson.

Junior Institution of Engineers.—Friday, December 9th. 39, Victoria Street, S.W. 7.30 p.m. "Management Graphics." Mr. T. G. Rose.
Friday, December 16th.—"Hardening and Quenching throughout the Ages." Mr. P. J. Haler.

Manchester Electrical Engineers' Dance.—Friday, December 9th. Midland Hotel, Manchester.

Association of Mining Electrical Engineers.—Saturday, December 10th. Cardiff. 6 p.m. "The Cost of Electric Power Transmission." Mr. J. Smith.
(Western Sub-Branch).—Saturday, December 10th. Swansea. "Cables." Mr. A. Bremner.

Institution of Post Office Electrical Engineers (South Wales Centre).—Monday, December 12th. "Wireless." Col. A. G. Lee.

Illuminating Engineering Society.—Tuesday, December 13th. Lighting Service Bureau, 15, Savoy Street, W.C. 6 p.m. "An Investigation of Electric Lighting in the Engineering Industry." Mr. J. L. H. Cooper.

Royal Institution of Great Britain.—Tuesday, December 13th. 21, Albemarle Street, W. 5.15 p.m. "A Year's Work in X-Ray Analysis." Sir W. Bragg. (Lecture IV).

Exhibition of Light and Heat in Medicine, Surgery, and Hygiene.—Central Hall, Westminster. December 13th-16th. 2.30 to 9 p.m.

Electrical Association for Women.—Wednesday, December 14th. Lighting Service Bureau, 15, Savoy Street, W.C. 7 p.m. "Some Difficulties in Dealing with Consumers." Miss M. G. Reading. 3 p.m. Visit to Touchbutton House, 85-86, Newman Street, W. "Colectric System of Heating." Mr. H. H. Berry.

Institution of Engineers-in-Charge.—Wednesday, December 14th. St. Bride Institute, Bride Lane, E.C. 7.30 p.m. "Lubrication and Lubricating Oils." Mr. S. E. Bowrey.

Institution of Electrical Engineers.—Thursday, December 15th. London, W.C. 6 p.m. "Squirrel-cage Induction Motors." Mr. D. B. Hoseason.
(Mersey and North Wales (Liverpool) Centre.—Monday, December 12th. University, Liverpool. 7 p.m. Eighteenth Kelvin lecture on "High Frequency Currents." Prof. E. W. Marchant.
(North-Eastern Centre).—Monday, December 12th. Armstrong College, Newcastle-on-Tyne. 7 p.m. "Squirrel-cage Induction Motors." Mr. D. B. Hoseason.
(North-Midland Centre).—Tuesday, December 13th. Hotel Metropole, Leeds. 7.15 p.m. "The Applications of Electricity in Warships." Mr. W. McClelland.
(North-Western Centre).—Tuesday, December 13th. Engineers' Club, Manchester. 7 p.m. Ordinary meeting.
(Western Centre).—Monday, December 12th. Swansea. "Illuminating Engineering." Mr. J. W. T. Walsh.
(Scottish Centre).—Tuesday, December 13th. Royal Technical College, Glasgow. 7 p.m. "The Stability of Large Power Systems" Mr. F. H. Clough.
(London Students' Section).—Friday, December 16th. Institution, London, W.C. 7 p.m. "Automatic Voltage Regulators." Mr. E. B. Watton.

British Electrical Development Association.—Friday, December 16th. Royal Society of Arts. "Electrical Progress in Cinematograph Pictures."

Notes.

The British Association.

The names of the presidents of sections for next year's meeting of the Association in Glasgow (September 5th to 12th) were announced this week. Sir William Ellis is the president of Section G.—Engineering.

The Great Electrical Hare Contest.

At the ninth annual ball of the North-East Coast Area Electrical Trades' Benevolent Institution, held at Newcastle on December 2nd, Mr. A. Andrews announced the results of the above contest. The final heat took place at noon on November 29th, when "Monach" beat "Tricky Tricity" by 603 hares, "Monach" having caught 2,037 and "Tricky Tricity" 1,434; that is, Mr. Barkes's and Mr. Brookhouse's dogs raised £101 17s. and £70 14s. respectively. Mr. Andrews thanked all who had helped in the contest, which, after paying all expenses, had raised over £400. The total number of hares caught by the 64 dogs was 8,435.

The winners of the prizes are as follows :—First prize (£32), Mr. F. Greenwell, of Low Fell, Gateshead-on-Tyne, Co. Durham, Card No. 7,980; second prize (£16), Miss A. Gaynor, of "Rothlea," The Avenue, Birtley, Co. Durham, Card No. 5,012. Miss Gaynor is in the employ of the British Insulated Cables, Ltd., at its offices, Newcastle-on-Tyne.

Appointments Vacant.

Chief assistant electrical engineer (£515) for the Lancaster Corporation Electricity Department; branch manager of the Birmingham depôt of the Stearn Electric Co., Ltd.; borough electrical engineer for the County Borough of Grimsby; draughtsmen (£160+) for the Royal Aircraft Establishment, South Farnborough. (See our advertisement pages to-day.)

Northampton Polytechnic Conversazione.

On Friday, December 3rd, the annual prize distribution and conversazione were held at the Polytechnic, Clerkenwell. Prior to the distribution, a portrait medallion to the memory of the late principal, Dr. R. Mullineux Walmsley, was unveiled by Mr. W. Reid, chairman of the Governing Body. The presentation of the prizes and certificates by Lord Riddell was preceded and followed by organ recitals by the Polytechnic organist, Mr. S. Dicker. All laboratories, workshops, &c., were thrown open to visitors, and the students demonstrated their machines and work. Gymnastic and boxing displays by the students and instructors were additional attractions. On Saturday the programme was continued, when an excellent concert was given by the Polytechnic Choral and Operatic Society and Orchestra, the evening being brought to a conclusion with dancing. The function proved a gratifying success.

Spark Ignition.

Prof. E. Taylor Jones, D.Sc., lectured on "Spark Ignition" to the Royal Philosophical Society at Glasgow on December 1st. The oldest theory was, he said, that a spark caused ignition simply by virtue of its heat, but recently the view was put forward that ignition by electric sparks was quite different, being electrical rather than thermal. The arguments in support of that view, however, seemed to have broken down on closer examination, and, in his opinion, the thermal theory of spark ignition was consistent with the observed facts.

E.A.W. Activities.

On November 30th a short lecture was given by Miss M. Partridge, B.Sc., at the E.L.M.A. Lighting Service Bureau, London, on "Simple Household Repairs." This was followed by some practical instruction, and every member of the class took part in repairing flexes, putting on lampholders, plug-tops, switches, and so on. On December 1st Mrs. Wilfrid Ashley presided over a well-attended meeting at the Bureau, when Mr. L. E. Buckell gave a lecture on "Colour Lighting for Home Decoration." Mr. Buckell traced the whole development of colour lighting and, with the aid of lantern slides, showed an analysis of the spectrum.

The last of the E.A.W. Evening Lectures is to be held on December 14th, at 7 p.m., and will take the form of a social at the Association's headquarters at Kensington Court.

At the second annual luncheon of the Glasgow and District Branch of the Association, Miss C. Haslett, director, said that the Association now had 2,000 members and six flourishing branches. She believed the E.A.W. was going to be a great force in the country. It was consulted by the Government, by headmistresses of schools, and other authorities on the subject of the woman's point of view. Letters had been received from all over the world inquiring as to the reason for the success of the organisation. Miss Haslett announced that the Association as a whole hoped to visit Glasgow in May next year. Miss Mary MacKirdy, of the Glasgow and West of Scotland College of Domestic Science, advocated the affiliation of the Domestic Science College to some other college which could give the students practical ground work in the use of electricity.

On November 28th members of the same branch visited the premises of the Clyde Valley Electrical Power Co. at Glasgow, where great interest was shown in the tastefully arranged showrooms.

Non-fatal 60-kV Shock.

To have received an electric shock at 60,000 volts and now to be suffering merely from acute nervous prostration is the luck of a man named Osvaldo Falli (27), who has been admitted to hospital at Spezia, says the *Evening News*. The patient shows no signs of a burn, and the doctors hold out hope of his recovery.

A Discussion on 132,000-V Cables.

At a meeting of the American Institute of Electrical Engineers in Chicago on November 29th the new underground cable, capable of carrying 132,000 volts, was to be discussed. The discussion was to cover the economics, design, manufacture, and use of this cable, which was described in our issues of May 1st, 1925, p. 717, and February 26th, 1926, p. 349. It has a core filled with oil for its entire length. The cable was first installed in the United States during the past summer—12 miles being owned by the New York Edison-United Companies' system and six miles by the Commonwealth Edison Company of Chicago. These are the only commercial installations of this type of cable in the world. According to Mr. P. Torchio, it is expected that cables of similar design will be able to carry as much as 220,000 volts, which is required for long-distance transmission and system interconnection. The new 132,000-volt cable, says Mr. Torchio, will permit the tying of the New York Edison-United system with power generated on the St. Lawrence River, or Niagara Falls, hundreds of miles away, and allow the direct introduction of this energy into New York City at a high voltage, without having recourse to step-down transformers and the necessary intermediate substations, switchgear, and attendance. The theory of the oil-filled cable is that through its collapsible oil reservoirs it responds readily to volumetric changes in oil and cable due to temperature changes. In this manner, the whole cable is kept constantly filled with oil under pressure, both in the hollow core of the conductor and throughout the surrounding insulation. Should the lead sheath be expanded or distorted, or the internal elements of the cable be displaced by temperature variation, or other causes, the spaces thus formed will be immediately filled with oil, while in a solid-insulation type voids would be formed, causing ionisation and ultimate failure.

Electric Traction and Health.

An interesting question was mooted some time back in Switzerland as to whether the electrification of the Federal Railways would have any influence upon the death-rate and health generally of the railway staff. Recent statistics have proved without a doubt that the introduction of electricity has exercised a very marked improvement in health conditions, and that, especially in the case of the "chauffeurs" and "aides-mécaniciens" (corresponding to steam-engine drivers and stokers), the amelioration is considerable, and the death-roll far lower; the statistics cover a period of nine years, and deal with the same members of the staff (who have grown that much older) and not with new railwaymen who have replaced those pensioned off, and who therefore would be younger men. The reasons for the improvement may be formulated as follows: an electric engine is less draughty than a steam-engine, and the driver can even regulate the temperature by the means of heating at his disposal. There is no stoking, so no risk is run of getting violently overheated and being obliged to continue work in clothes damp with perspiration; freedom from fumes, smoke, and coal-gas is ensured; not only is there a considerable gain in personal cleanliness, but also less risk of blood-poisoning caused by dirt getting into a cut or sore. As there is no furnace to feed, the stoker avoids bodily fatigue, and the speed and movements of electric engines are more regular and less pronounced, which has a beneficial effect upon the nervous system. It has been proved that since 1917 the number of days of service missed by the Federal Railways staff because of illness has steadily decreased, and that even when a man has been ill he has been able to start his work sooner than he otherwise would have done.

High-pressure Cables.

Referring to the paper read by Mr. P. Dunsheath before the British Association (abstracted in our issue of September 16th, p. 479), the Director-General of Messrs. Geoffroy-Delore, of Clichy (Seine), France, writes to us drawing attention to their French patent, No. 367,774, taken out in July, 1906, for "Improvements in electric cables for high pressure." Their contention is that the "metallised" types of cable ascribed to Mr. Höchstadter had been studied by themselves at that early date. The specification refers to the distribution of the potential in the thickness of the insulation, and shows that the potential gradient is at a maximum next the conductor; it then describes the insertion of conducting sheaths in the substance of the insulation, which are maintained at definite pressures so as to modify the potential gradient in the direction of uniformity, enabling the cable to carry a higher pressure, or the same pressure with a thinner dielectric. The intercalated sheaths may be perforated or not, and may consist of spiral or braided wires, or of solid tubular metal. In the case of a metal-sheathed cable, the outermost metallic cover of each core may be in contact with the metallic sheath or armour, as in the case of the cables in question. The claim is made for improvements consisting in the intercalation in the thickness of the insulating material of one or more layers of conducting material at potentials graded between that of the core and that of the external layer.

Fatality.

John McNiven, electrical engineer, while motor-cycling from his work in Glasgow to his home at Carmunnock, was killed by crashing into a cart in the darkness on the night of November 28th.

Croydon's Scheme for Contractors.

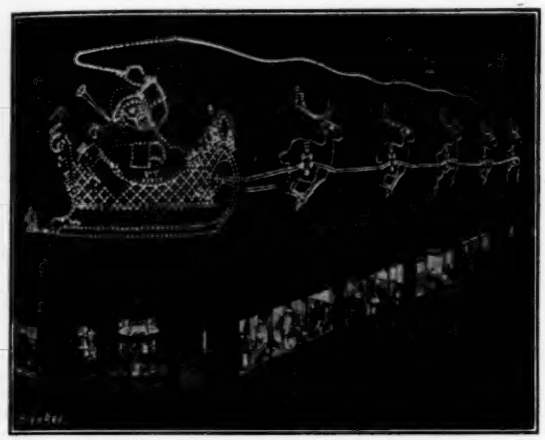
The Croydon Electricity Committee has drawn up a scheme in conjunction with local registered contractors for the regulation of sales, hire-purchase and hire of electrical installations and apparatus by the Corporation. The agreement regarding the hire-purchase of appliances is the one which was referred back a few months ago. It provides that when business is introduced by a contractor he shall be given a discount upon the amount received, and that the work of installation shall also be carried out by contractors.

The scheme for the hire-purchase of installations, by which a contractor carries out the work on an agreed schedule of prices, is also re-introduced. As an alternative to hiring, the Corporation will hire-purchase and maintain cookers, water heaters, wash boilers, and similar apparatus. Where the contractors have not a suitable scheme for the hire-purchase of electric washers, refrigerators, and other high-priced apparatus, the Corporation is to carry on this business. The Corporation, as far as possible, will change over the present scheme of hiring low-priced utility radiators from hire to hire-purchase. Consumers will purchase other radiators for cash from the contractors at the showrooms. The Department will hire-purchase any other apparatus where it is generally agreed that the course is desirable. It is proposed (in the first instance for a period of one year) that the Croydon registered electrical contractors should undertake to stock part of the showrooms with lighting fittings and apparatus decided upon by the borough electrical engineer (Mr. A. C. Cramb). This apparatus will be for direct sale on behalf of the contractors, the Department receiving 5 per cent. of the list price for handling expenses. Each contractor in turn will be given an opportunity of displaying electrical goods in the showroom windows for a definite period. The registered contractors will appoint a small committee to settle the arrangements and co-operate with the electrical engineer in carrying out the proposals. The scheme for the hire-purchase of apparatus and installations remains similar to that outlined in our issue of July 8th (p. 56), at which time it was announced that the Corporation had allocated £10,000 to meet the expenditure involved. The work can only be carried out by registered electrical contractors, and the scheme provides for payment by the consumer in two years for apparatus and five years for installations.

A Large Electric Sign.

The accompanying illustration is of an animated electric sign which has recently been installed over Messrs. Whiteley's premises, London, and is claimed to be the largest one ever erected in this country and the third largest in the world, being 300 feet in length and 48 feet high. It is a representation of Father Christmas in a sleigh loaded with presents and drawn by five pairs of reindeer. The reindeer gallop and Father Christmas smiles, winks his eye and cracks his whip, which is 240 feet in length. Flurries of snow rise from the runners of the sleigh.

Approximately 6,000 lamps are used in the display, 500 14-V 5-watt lamps, for the outlining of the toys and the face of Father Christmas, and the rest are 100-V, 10-watt sign-type lamps. There are 102 " ways " on the flashing mechanism, of which 58 are required for the operation of the whip and the rest for the galloping reindeer. A small " border chaser " flasher is used for the flurrying snow, and a clockwork flasher for the winking eye of Father Christmas. Ten different colours are used in the display and all colouring is done by



A Large Electric Sign in London.

means of natural glass colour hoods which are fastened over the lamps. For the 10-watt lamps a 200-volt d.c. supply from Messrs. Whiteley's own generating plant is used, all the wiring being in series-parallel. For the miniature-lamp lighting a Ferranti transformer is connected to district a.c. supply. The wiring is broken up into approximately 200 circuits, each fitted with d.p. fuses. The frame is of galvanised sheet-steel, two tons in all, with porcelain Edison screw-cap lamp-holders. The sign is a " permanent " structure, made for easy erection and dismantling so that it can be used again on the same or other Selfridge stores.

The sign has been constructed and is being maintained by the Sign Construction Company, Ltd.

Large Power Plant in America.

The United Electric Light and Power Co. of New York has placed with the Westinghouse Electric and Manufacturing Co. an order for a 165,000-kW turbo-generator and two surface condensers, with the necessary auxiliaries for circulating condensate and air removal. According to *Power*, the new generator will be installed in the Hell Gate power station at New York. The unit will be of the cross-compound type and operate at a speed of 1,800 r.p.m. Steam will be supplied to the throttle at 265-lb. gauge pressure, 200 deg. F. superheat, and will pass into the condenser at a pressure of one inch of mercury absolute. The two main generators for operation at a speed of 1,800 r.p.m. will each have a rating of 80,000 kW, 85 per cent. power factor, producing 3-phase, 60-cycle current at a potential of 13,800 V. An auxiliary generator rated at 5,000 kW, 80 per cent. power factor, producing 3-phase, 60-cycle current at a potential of 2,400 V will also be furnished. Directly-connected exciters will be supplied for both the main and auxiliary generators. One condenser will serve the above generator unit, and the other condenser will serve the 160,000-kW cross compound unit, purchased over a year ago for delivery next year. Each of the condensers is of the two-pass design, having 137,500 sq. ft. of tube surface, and arranged to circulate 155,000 g.p.m. by two motor-driven circulating pumps. The air-removing equipment for these condensers will be of the three-stage air-ejector type. These condensers will be the largest two-pass surface condensers in the world.

Heavy Electrical Engineering.

In his recently published book on " The Basic Industries of Great Britain " (published by Messrs. Ernest Benn, Ltd., price 25s.), the Rt. Hon. Lord Aberconway, P.C., devotes one chapter entirely to the above subject. He briefly traces the commercial electrical development in this country from the speculation forty years ago in the shares of " Father Brush " to the present day. In 1925 Great Britain alone spent £57,000,000 on electrical goods, as compared with £90,000,000 in Germany, and £279,000,000 in the U.S.A. Great Britain secured 35 per cent. of the world exports during that year. From the 10,000-kW turbo-alternator which was considered a few years ago to be the limit of manufacturing design, sets of 100,000 kW have been ordered, and the latter figure will be largely exceeded as the high pressures used in connection with overhead lines are increased. The author criticises the policy of the large British electrical firms of undercutting each other when quoting for contracts abroad.

The author outlines the history, structure, financial position, and activities of the " Big Four " electrical companies—the General Electric Co., Ltd., the British Thomson-Houston Co., Ltd., the Metropolitan-Vickers Electrical Co., Ltd., and the English Electric Co., Ltd., and many other important firms are referred to in relation to the products they specialise in.

Cable Jointing.

In an interesting lecture on " Cable Jointing," given before the Southampton University College Engineering Society recently by Mr. R. E. Horley, A.M.I.E.E., Messrs. Pirelli-General, Ltd., he described the process of cable jointing on the tight paper tube covering principle.

Industrial Research.

In order to provide a co-ordinated body for determining the lines of General Industrial Research, Imperial Chemical Industries, Ltd., has established a Research Council which will be presided over by Sir Alfred Mond, chairman of the company; the other members will be Dr. G. C. Clayton, M.P., Col. G. P. Pollitt, and Mr. J. Rogers (directors), Major F. A. Freeth, F.R.S., Dr. E. F. Armstrong, F.R.S., Dr. R. E. Slade, Mr. H. A. Humphrey, and Sir Frederick Keeble, F.R.S., all of whom are associated with Imperial Chemical Industries, Ltd., or its subsidiary companies; and Professors F. G. Donnan, F.R.S., R. Robinson, F.R.S., W. A. Bone, F.R.S., and F. A. Lindemann, F.R.S., and Dr. E. K. Rideal. Major A. E. Hodgkin will be secretary. The company has felt that co-ordinated industrial research in Britain has suffered in the past from the lack of a sufficiently close association with the academic and scientific worlds. The main function of the Research Council will be advisory, and it will act as a clearing-house for ideas; steps have also been taken for following up in the most energetic manner all promising matters which may come before it. The Council will provide a close liaison between industry and the Universities, and will promote both long-distance scientific industrial research and research of the so-called purely academic type. This is the first body of its kind to be established in this country, though similar organisations have been of great service to both science and industry in other countries. The objective is to place British practice upon more than competitive terms with modern achievements and organisations elsewhere. It is felt that by such means Britain may retain her supremacy among the industrial nations of the world.

Safety of Life at Sea.

The International Convention of 1914 on Safety of Life at Sea was admittedly incomplete in some respects, and has not yet been put into operation as an international standard. Great Britain, as the country in which the Conference met, was charged with the duty of completing the standard by promoting common agreement, and the Board of Trade has accordingly issued (H.M. Stationery Office, price 6d. net) a memorandum addressed to the Foreign Office which embodies the work done in England since 1914 and contains tentative suggestions for the amendment of the Convention and for the holding of another conference. Though the Convention was not ratified by all the signatory powers, certain countries had already adopted measures requiring certain ships to be fitted with wireless-telegraph apparatus and others subsequently adopted similar measures, based on the Convention regulations. The Merchant Shipping (Wireless Telegraphy) Act, 1919, prescribed that all sea-going ships of 1,600 tons gross and upwards and all sea-going passenger steamships carrying more than twelve passengers, sailing from the ports of this country, should be fitted with wireless-telegraph apparatus and maintain a wireless service as provided in rules to be made for this purpose by the Board of Trade; power was also given to exempt from the obligations imposed by the Act when the provision of apparatus was considered unnecessary, or unreasonable. Rules were brought into force in September, 1920 (they divided ships into three classes) and on October 1st, 1927, they were superseded by the new rules referred to below. The British authorities have not exercised the power of exemption to anything like the extent suggested in the Convention, but Article 34 of the Convention provided that if an efficient automatic calling apparatus were invented, the continuous watch on ships might be maintained by such means. Since two types of automatic apparatus have now been officially approved, revised rules have been made by the Board of Trade and the General Post Office to meet the new conditions; they stipulate that ships of Class I fitted with the approved automatic alarm apparatus shall carry two, in place of three, operators; that Class II ships shall be required to replace the present watchers by the automatic apparatus; and in the case of Class III ships fitted with the automatic apparatus, the obligation to keep the full specified periods of watch remains only until further rules shortening the amount

of watch in a suitable manner can be prepared; the "alarm signal" may be used only in cases of distress, and not for any other purposes. It may be added that the British authorities are of the opinion that if actual experience of these alarm devices at sea should, as is confidently anticipated, prove successful, all that need be required for safety purposes on any ship is a wireless-telegraphy installation, an approved automatic apparatus, and one qualified operator. The question to be considered is whether, in view of all the circumstances, a satisfactory basis can be found for a uniform international regulation.

Home Office Industrial Museum.

As indicated in our last issue, the above Museum at Horseferry Road, Westminster, was opened to the public from December 5th. The Museum is a permanent exhibition of methods and appliances for promoting the safety, health and welfare of the industrial workers in the industries which come under the Home Office administration. The establishment of the Museum was decided upon and the building was erected before the war, but before the Museum could be established the building was taken for military purposes. The restoration of the building and the organisation and collection of the exhibits were taken in hand some two years ago. The exhibition is the first of its kind in this country. Its purpose is to show the best methods prevailing which are known to the Home Office for protecting the industrial worker. It will be open to the general public between certain hours, but it is mainly intended for those who are directly concerned with the problems of safety, health and welfare in industry. It is hoped that the engineering and technical schools and colleges will make use of the opportunities afforded by the museum, and will send their students there to learn the principles of industrial safety. The exhibits, which have all been either given or lent by manufacturers and firms, have been selected solely with a view to their usefulness to the objects indicated, and every suggestion or offer received from inside or outside the department has been tested by this standard. The "safety" exhibits consist chiefly of the actual machines, plant and appliances as they would be installed in factories or elsewhere; and they are supplemented by an extensive collection of photographs of actual installations in different parts of the country. A separate section is devoted to electrical exhibits, and contains examples of approved types of lampholders, switches, fuses, distribution boards, and so on. One case is set aside as showing "how not to do it," and contains a number of "obsolete" types of lampholders and portable apparatus, each of which has been responsible for a fatal accident. Two sections are devoted to illustrating the principles of efficient ventilation and lighting; in the latter a number of showcases are fitted up with "daylight" and ordinary electric lamps for demonstrating the effects of artificial lighting on various colours. The Home Office gratefully acknowledges the assistance which it has received in the establishment of the museum from many quarters, including H.M. Office of Works, the National Physical Laboratory, and various manufacturers and institutions. The original cost of the erection of the building was £17,309, but since the war a further sum of £2 613 has been spent upon it. The available floor space for exhibition is over 10,000 sq. ft.

Institution Notes.

Institution of Electrical Engineers.

SCOTTISH CENTRE.—At the annual dinner of the Scottish Centre of the Institution of Electrical Engineers at Glasgow on Tuesday, November 29th, Sir A. R. Duncan, chairman of the Central Electricity Board, and Mr. Archibald Page, president of the Institution and chief engineer of the Board, were present and spoke of the future of the industry. Sir Andrew proposed the toast of the Glasgow Corporation. He assured the company that the Board was grateful to the electrical undertakings of Scotland for their helpful co-operation when it was launching its area scheme. He also thanked Glasgow Corporation for the help the Board had received in preparing the route of the transmission lines. Perhaps they had paid too great regard to the amenity of the city, but they had done so in the interests of the citizens, and the Board had tried to meet them as far as it was possible to do so. Councillor T. Stark Brown replied. Sir Frederick C. Gardiner proposed the toast of the Institution. He appealed to all concerned to co-operate with the Electricity Board, and said that in Sir Andrew Duncan they had an ideal man for the position of chairman. Mr. Archibald Page replied. He referred to the growth of the Institution which, he said, had well over 12,000 members. Its extension was reflected very definitely in the application of electricity. Already any telephone subscriber in Britain was able to ring up any subscriber in the United States or Cuba. It was not too far away to contemplate that they would be able to ring up their kinsmen throughout the Dominions and throughout the world just as they could ring up their relatives in this country. That was bound to add new spice to life, and it would strengthen and reinforce the bonds of Empire. Again, they had the fascinating problem of television. There was quite a lot said about it which was, in a sense, misleading, but the demonstrations that had taken place indicated the probability of a commercially practicable solution of the problem being reached eventually. Whether that was going to be an unmixed blessing was not for him to say, but the possibilities of vocal and visual communication were exceedingly great. In the sphere of electricity supply the future was very rosy. The industry was co-operating with the Board in a mass attack on obsolete methods of production as a first stage to better things. There was no doubt that success could be assured, but they must not be impatient, and they must avoid, at all costs, the idea that the El Dorado was going to arrive in the current year. They had entered the electrical age. Nobody could predict what development would come along, but it required little stretch of imagination to see that the possibilities were boundless. It all demanded great effort on their part. All expansion meant change of method. All progress depended on trial and experiment. It was often mixed with disappointment and possible failure. It was just there that the interchange of knowledge through the Institution could best take place. Isolation of brains was all very well, but co-ordination achieved a great deal more.

The Institution of Chemical Engineers.

This week a conference has been held by the Institution, commencing on Wednesday, when the president (Sir Alexander Gibb) took the chair, and Mr. Norman Swindin read a paper on "Submerged Flame Combustion." Yesterday was to be devoted to a discussion on "Refrigeration," under the chairmanship of Mr. J. Arthur Reavell, vice-president; and to-day, with Mr. W. A. S. Calder, vice-president, in the chair, Mr. W. J. Jones will read a paper entitled "The Problem of Industrial Lighting, with some Reference to the Chemical Industry." In the evening two other papers will be read.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements

On November 30th a portrait of Prof. J. A. FLEMING, D.Sc., F.R.S., which was painted by Sir William Orpen, R.A., and exhibited at the Royal Academy this year, was presented to University College, London, where Dr. Fleming was professor of electrical engineering from 1884 to 1926. Mr. A. A. Campbell Swinton, chairman of the Committee of the Fleming Portrait Fund, presided and made the presentation, and Lord Chelmsford, chairman of the College Committee, receiving the portrait, referred to the distinction conferred upon the College by Dr. Fleming's work and scientific achievements. Professor E. G. Coker, Dean of the Faculty of Engineering, also dwelt upon the wide scope of Dr. Fleming's contributions to electrical science, and to wireless communication in particular. A copy of the portrait was presented to Dr. Fleming, who, on the following evening, presented it to the Institution of Electrical Engineers.

The Walthamstow Urban Council has increased the salary of the electrical engineer from £1,200 a year to £1,302, as from April 1st last.

Mr. COLIN M. SCOTT, formerly of Kirkintilloch, near Glasgow, has sailed for Bombay to take up the duties of assistant divisional engineer, Posts and Telegraphs, Indian Civil Service, to which he was recently appointed.

According to the Australian Press the Sydney City Council, by 10 votes to 6, passed an extra allowance of £1,000 a year to the general manager of the electricity department (Mr. MACKAY), and two-thirds of that amount to the deputy general manager (Mr. MALING) during the erection of the Bunnerong power house.

The Chesterfield Corporation has fixed the salary of the borough electrical engineer, Mr. D. H. DAVIES, at £800 per annum, excluding emoluments.

We are glad to state that Mr. W. A. CHAMEN, engineer and general manager of the South Wales Electrical Power Distribution Co., who has recently been seriously ill, is making a very satisfactory recovery, which, however, must necessarily be somewhat slow.

At the annual meeting of the South Coast Section of the Electrical Power Engineers' Association on November 26th, the retiring chairman, Mr. A. J. Ryan, of Hastings, was presented by the members of the Hastings Section with a gold watch in recognition of his ten years' services on behalf of the electrical power engineers on the South Coast. He is succeeded in the chair by Mr. A. G. HISCOCK, of Portsmouth.

Mr. A. HUGH SEABROOK has joined the board of the Brightlingsea Electricity Supply Co., Ltd., and Messrs. A. Hugh Seabrook & Partners have been appointed consulting engineers to that company, the Bourne Urban District Council and the Wickford and District Electricity Supply Company.

Messrs. WILLIAM MCGILL, IAN C. A. MURRAY, and A. M. MACTAGGART, all of whom have been engaged in different departments of the business for many years, have been elected as additional directors of Balfour, Beatty & Co., Ltd., electrical engineers.

Captain E. GUTHRIE BOWERS, M.C., A.M.I.E.E., who has been assistant mechanical and electrical superintendent to the Bombay Port Trust since 1921, has been appointed electrical and mechanical engineer to the Madras Port Trust. He is taking up his new duties in January.

On his departure to take up an appointment as district engineer with the Yorkshire Electric Power Co., Mr. F. C. NEALE was presented by the staff and employés of the Walsall Corporation Electric Supply Department with a set of drawing instruments and a travelling case. The presentation was made by Mr. H. A. Howie, the engineer and manager.

Mr. R. T. FLEMING, A.M.I.E.E., who is joining the staff of the Insulating Varnish Department of Messrs. Pinchin, Johnson & Co., Ltd., in Aldwych, London, on January 1st, has had a unique experience in electrical insulation research. He worked in the Research Department of the British Westinghouse Co., Ltd., of Trafford Park, and subsequently in the more fully equipped laboratories of the Metropolitan-Vickers Electrical Co., Ltd. He was in charge of the high-pressure side of this work, having testing facilities up to a pressure of 500,000 volts. Mr. Fleming has also done extensive work in connection with the British Electrical and Allied Industries Research Association, particularly in connection with the study of the properties of insulating varnishes and compounds.

Obituary.—MR. G. H. THOMPSON.—The death took place on November 24th, at the age of 65 years, of Mr. George Heckles Thompson, electrical engineer, of Hetton-le-Hole, Co. Durham. He was a son of the late Mr. John Thompson, to whose business he succeeded, and which he conducted up to the time of his death.

MR. F. E. GRIPPER.—We regret to learn at the moment of going to press that Mr. F. E. Gripper, M.I.E.E., director of the Urban Electric Supply Co. and many Edmundson companies, passed away on Wednesday morning at his home at Putney, after a long illness.

Financial Section.

New Companies, Returns of Share Capital, Debenture Changes, Reports of Electrical Companies, Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

Erewash Electric Wire Co., Ltd.—Private company. Registered November 26th. Capital, £3,000 in 2,500 6½ per cent. cumulative preference shares of £1 each and 2,000 ordinary shares of 5s. each. Objects: To acquire the business of manufacturers of insulated wire now carried on by H. A. Tweedale and Emmeline Wallis, as "The Erewash Electric Wire Company," at Erewash Mills, Bennett Street, Long Eaton. The subscribers (each with one preference share) are: H. A. Tweedale, "Wayside," Spinney Road, Long Eaton, electric cable manufacturer; Hilda Case, Poplar Road, Breaston, Derby, clerk. Registered office: Erewash Mills, Bennett Street, Long Eaton.

A. W. Knight & Co., Ltd.—Private company. Registered November 28th. Capital, £1,000 in £1 shares. Objects: To acquire the business of radio and electrical engineers carried on by A. W. Knight and E. Coleman, trading as Knight & Co. The first directors (to number not fewer than two or more than five) are:—A. W. Knight, 32, St. Mary's Road, Peckham, S.E.15, radio engineer; E. Coleman, 25, Westbourne Road, Forest Hill, S.E.23 (both permanent). The latter signs as managing director. Registered office: 180, Tower Bridge Road, S.E.1.

Saynerphone (H. P.) Sales Co., Ltd.—Private company. Registered November 28th. Capital, £4,000 in £1 shares. Objects: To carry on the business of retailers by means of hire-purchase and deferred payment agreements of wireless sets, accessories, &c. The first directors are:—H. Sayner (permanent managing director), 28, Saltaire Road, Shipley, Yorks; P. H. Leach, 22, Bingley Road, Shipley, Yorks. Secretary: P. H. Leach.

Eastnor Tramway, Traction and Electrical Co., Ltd.—Private company. Registered November 28th. Capital, £2,000 in £1 shares. Objects: To carry on the business of electrical, manufacturing, mechanical, radio, and automobile engineers, specialists in tramway equipment, switchgear, &c. The first directors are:—J. W. Kirby, 30, Marlborough Road, Stretford, Manchester, engineer; F. J. Swann, 68, King Street, Stretford, Manchester, engineer; W. Shawcross, 132, Radnor Street, Hulme, Manchester, metal merchant. Qualification, £200 shares. Registered office: 11b, Eastnor Street, Old Trafford, Manchester.

Asgood Accumulator Co., Ltd.—Private company. Registered November 24th. Capital, £100 in £1 shares. To carry on the business of manufacturers of and dealers in all kinds of accumulators, power and radio engineers, &c. The first directors are:—J. T. Campbell, 36, Westmorland Road, Urmston, engineer; J. E. Campbell, Urmston, engineer; J. H. Fletcher, 43, Bradshaw Street, Higher Broughton, Salford, electrical engineer. Qualification, £1.

Domestic Electrification, Ltd.—Private company. Registered November 26th. Capital, £10,000 in £1 shares. To carry on in Great Britain and Northern Ireland, the Irish Free State and elsewhere the business of manufacturers and sellers of electric fires, cookers, heaters and other electrical appliances for domestic and general use, electrical, mechanical and general engineers, chemists, manufacturers of and dealers in chemical materials, substances, fluids and gases, &c. The subscribers (each with one share) are:—A. Gordon, Budleigh, Ford Road, Ashford, Middlesex, company secretary; E. Louis, 28, Meteor Road, Westcliff-on-Sea, C.A. The first directors (to number not fewer than two or more than six) are:—Sir Henry Cowan, F. R. Smith, F. Thorp and J. A. Macleod (all nominees of Measurement, Ltd., which company has the right of nominating the directors, while holding a majority of the issued ordinary shares). The directors so nominated may hold office for five years. So long as Measurement, Ltd., has the right of nominating directors, the directors so nominated shall require no other qualification, and so long as the said company or its nominees hold 30 per cent. of the ordinary shares, any director of the company who is also a director of Measurement, Ltd., shall be eligible as a director of the company without other qualification. Qualification of other directors (other than a managing director), £200. The registered office is at Townsend House, Greycoat Place, Westminster, S.W.

Brunswick Engineering Co., Ltd.—Private company. Registered November 28th. Capital, £450 in £1 shares. Objects: To acquire the business of the Brunswick Engineering Co., Ltd., and to carry on the business of electricians, electrical, mechanical, hydraulic, motor and general engineers, &c. The subscribers (each with one share) are:—A. E. Fournier, "Odd Chimney," Dorset Road, Merton Park, S.W.19, solicitor; D. V. Turner, Plumtree House, Rusthall Avenue, Bedford Park, W.4, private secretary. F. J. Humphrey shall be first director and chairman. Solicitors: Amery Parkes & Co., 1, Arundel Street, W.C.2.

Radios Electrical, Ltd.—Private company. Registered November 30th. Capital, £500 in £1 shares (200 ordinary and 300 7 per cent. cumulative preference). Objects:—To acquire the business carried on at 8, Malden Road, New Malden, Surrey, as Radios, to adopt an agreement with Radios (Odom & Frewer), and to carry on the business of electricians, manufacturers of and dealers in electric lamps, telephonic, telegraphic, and wireless apparatus, heating and cooking apparatus, &c. The first directors are:—Major F. Odom, "Highlands," 2, Claremont Gardens, Surbiton, electrical engineer; Edward G. S. Frewer, 26, Malden Hill Gardens, New Malden, electrical engineer; George Byfield, 32, Lushington Road, Willesden, N.W.10, certified accountant (all permanent, subject to holding 100 shares each). Secretary: G. Byfield. Registered office: 8, Malden Road, New Malden.

Everose Electrical Co., Ltd.—Private company. Registered November 30th. Capital, £200 in 1s. shares. Objects:—To carry on the business of electricians, manufacturers, generators, accumulators, suppliers and distributors of electricity, &c. The directors are:—F. J. Rosenberg, 91, Pall Mall, Leigh-on-Sea; E. J. Evershed (managing director), 60, The Ridgway, Wimbledon, Surrey. Secretary: G. E. Evershed. Registered office: Thanet House, 231, Strand, W.C.2.

A. H. Seager, Ltd.—Private company. Registered December 1st. Capital, £1,200 in £1 shares. Objects:—To carry on the business of manufacturers of and dealers in wireless, telegraphic and telephonic and electrical apparatus, &c. The first directors are:—T. T. Tilling, Orient House, Belmont, Surrey, contractor; A. H. Seager, Orient House, Belmont, Surrey, engineer. Qualification, £100. Remuneration, £25 each per annum. Solicitors: Gush, Phillips, Walters and Williams, 5, Throgmorton Avenue, E.C.2.

Hooper & Stones, Ltd.—Private company. Registered December 1st. Capital, £1,000 in £1 shares. Objects:—To carry on the business of electrical engineers and fitters, cable manufacturers, electric lamp manufacturers, wireless apparatus manufacturers, &c. The subscribers (each with one share) are:—D. Hooper, 15, Mount Carmel, Derby, electrical engineer; A. H. Lewer, 139, Tamworth Road, Long Eaton, Derbyshire, electrical engineer; B. N. Purdy, 1, Elm Avenue, Long Eaton, Derbyshire, electrical engineer. Solicitors: J. J. Spencer & Son, 13, Park Row, Nottingham.

Official Returns of Electrical Companies.

Yates & Thom, Ltd.—Satisfaction in full on October 11th, 1927, of debenture stock secured by trust deed dated September 25th, 1905, securing £130,000.

Clear Hooters, Ltd.—Charge on the company's undertaking and all property dated October 19th, 1927, to secure £300. Holder: J. H. Mills, Heath Lea, Castle Bromwich.

Hadden & Pearce, Ltd.—Capital, £5,000 in £1 shares. Return dated August 12th, 1927. 2,502 shares taken up. £2,002 paid, £500 considered as paid. Mortgages and charges: £1,300 debenture.

Elstree Radio, Ltd.—Capital, £100 in £1 shares. Return dated March 31st (filed November 2nd), 1927. Four shares taken up. £4 paid. Mortgages and charges, nil.

Cullompton Electric Supply Co., Ltd.—Capital, £6,000 in £1 shares. Return dated June 2nd, 1927. 4,028 shares taken up. £3,428 paid, £600 considered as paid. Mortgages and charges, nil.

British Electrical Maintenance & Insurance Co., Ltd.—Capital, £1,000 in £1 shares. Return dated August 28th, 1926 (filed June 28th, 1927). 999 shares taken up. £999 paid. Mortgages and charges, nil.

Rhondda Tramways Electric Supply Co., Ltd.—Capital, £100 in £1 shares. Return dated May 5th, 1927. Seven shares taken up. £7 paid. Mortgages and charges: £54,000.

Scott Insulated Wire Co., Ltd.—Capital, £14,000 in 4,000 preference and 10,000 ordinary shares of £1 each. Return dated January 14th (filed June 10th), 1927. 2,075 preference and 10,000 ordinary shares taken up. £12,075 paid. Mortgages and charges, nil.

Luminad, Ltd.—Issue on October 26th of £100, and on November 10th, 1927, of £200 debentures, parts of a series already registered.

Multi-Way Earthing Clip, Ltd.—A. G. Partridge, of 3, Warwick Court, Gray's Inn, W.C.1, ceased to act as receiver or manager on November 25th, 1927.

W. Sanders & Co. (1915), Ltd.—Capital, £2,000 in £1 shares. Return dated December 31st, 1926 (filed October 5th, 1927). 1,005 shares taken up. £5 paid. £1,000 considered as paid. Mortgages and charges, £1,000.

La Plata Electric Tramways Co., Ltd.—Capital, £450,000 in 200,000 preference and 250,000 ordinary shares of £1 each. Return dated May 11th, 1927. All shares taken up. £170,007 paid on 170,007 preference shares. £279,993 considered as paid on 29,993 preference and 250,000 ordinary shares. Mortgages and charges, £93,364.

"M.K." Electric, Ltd.—Capital, £2,000 in £1 shares. Return dated April 12th, 1927. All shares taken up. £768 paid. £1,232 considered as paid. Mortgages and charges, £6,600.

Wolverhampton and District Electric Tramways, Ltd.—Capital, £200,000 in £5 shares. Return dated June 1st, 1927. 32,200 shares taken up. £159,812 10s. paid (being £5 per share on 31,950 shares and 5s. per share on 250 shares). Mortgages and charges, £76,000.

O. C. Hawkes, Ltd.—Capital, £200,000 in 100,000 preference and 100,000 ordinary shares of £1 each. Return dated March 15th (filed July 8th), 1927. 85,000 ordinary and 85,200 preference shares taken up. £105,095 paid. £65,105 considered as paid. Mortgages and charges, nil.

Tricity Restaurants, Ltd.—Debenture dated November 14th, 1927, to secure £5,000 and further advances, not exceeding therewith £10,000, charged on the company's property, present and future, including uncalled capital. Holders:—British Electric Transformer Co., Ltd., Hayes, Middlesex.

Radielle Co., Ltd.—Three debentures to the registered holders dated November 19th, 1927, to secure £500, £500 and £285 respectively, charged on the company's undertaking and property, present and future, including uncalled capital.

Electradio Co., Ltd.—Debenture dated November 21st, 1927, to secure £1,000, charged on the company's property, present and future, including uncalled capital. Holder:—Mrs. A. S. Black, 25, Westbourne Grove, W.2.

Cambridge Electric Supply Co., Ltd.—Satisfaction in full on September 30th, 1927, of "C" debentures dated August 10th, 1920, to March 31st, 1923, securing £30,000.

City Notes.

British Columbia Electric Railway Co., Ltd.

Mr. J. Davidson (deputy chairman) presided at the annual meeting on December 2nd, in the absence through ill-health of the chairman, Mr. R. M. Horne-Payne. In moving the adoption of the report and accounts, which were reviewed in our last issue (p. 961), Mr. Davidson referred to the chairman's work for the company and to the presence of Mr. Kidd, the president of the company. He proceeded to say that to meet the growing demands upon their services they had to raise fresh capital and they thought that that could best be done by the issue of deferred ordinary shares. Accordingly the existing holders of preferred and deferred ordinary shares had been offered new deferred shares at par in the proportion of about 30 per cent. of their holdings. Mr. Kidd then addressed the meeting and said that about half the company's revenue was obtained from its transportation system and the other half from light, power and gas. It had been said that tramways were doomed to extinction but his view was that in the larger and more congested cities the tramcar was indispensable and 'buses were only useful as terminal feeders. Their present street-car system, supplemented as it was by 'buses, had a very permanent place in the life of the community. The transmission line from Lake Buntzen and Stave Lake to Vancouver had been reconstructed to reduce the possibility of breakdowns to a fraction of what it was. Improvements had also been made in the switchgear in generating and sub-stations. Other developments had been made, including the substitution of an incandescent system of lighting in Vancouver for the old arc lighting. In the railway department much of the old temporary track in Vancouver and Point Grey had been replaced by permanent double tracking. After referring to other improvements in the railway and gas departments Mr. Kidd referred to the general prospects of British Columbia and Canada. He quoted statistics to show the improvements which had occurred during the past few years in industry and trade, and said that he had every confidence in the future of the province and consequently of the company. To anticipate the demand for electricity $11,000,000 was being spent on the hydro-electric undertaking at Bridge River some 135 miles from Vancouver. The first development would occupy at least three years; he had no doubt that the revenue earned by the undertaking would justify the large expenditure. The report and accounts were adopted, and subsequently resolutions were passed increasing the capital by 1,000,000 new shares of £1 each and altering the method of remunerating the directors.

Burma Electric Supply Co., Ltd.

Mr. C. O. Webb (chairman) presided at the annual meeting on November 30th. In presenting the report and accounts (ELECTRICAL REVIEW, November 25th, p. 917) he said that the lighting and power branch continued to show steady progress, but the traffic receipts had been adversely affected by motor-'bus competition. He reminded shareholders that although the ordinary dividend was the same (8 per cent.), it was being paid on capital increased from £100,000 to £120,000. The capital expenditure during the year was mainly on account of motor omnibuses and equipment for them. Reverting to the question of competition, Mr. Webb said that there was at present no control over omnibuses, but if the competition was properly controlled the ultimate result would be satisfactory to the company. The company's existing concessions for electricity supply and tramways expired in 1941, when the local authorities had the option of purchasing the business. They had been asked by the Government to reduce the voltage of supply from 500 to 250; that would cost the company £45,000 and not add to the earnings in any way. Accordingly the directors had placed a proposal before the Government that the company should be given a concession for 50 years free from any question of purchase.

The report and accounts were adopted, and a resolution was passed altering the articles of association to comply with the requirements of the London Stock Exchange to enable the company's shares to be quoted.

Western Electric Distributing Corporation, Ltd.

The statement of accounts for the year ended June 30th last shows that the profit was £12,036, to which is added £704 brought forward, making £12,740. After paying interim dividends there remains a balance of £8,862, which it is proposed to allocate as follows:—Final dividend of 3 per cent. on the cumulative preference shares (making 6 per cent. for the year) and on the new preference shares at the rate of 6 per cent per annum from the dates of payment; final dividend of 7 per cent. (making 10 per cent.) for the year on the ordinary shares and at the rate of 10 per cent. on the new shares; writing off one-half of the preliminary and capital-increase expenses (£806); leaving £518 to be carried forward. During the year the nominal share capital was increased to £250,000 by the creation of 50,000 new £1 ordinary shares; these were offered to shareholders at a premium of 11s. 6d. each. The preference share capital was also increased by the issue of 22,836 shares. Mr. S. F. H. Edwards has retired from the board; his place has been taken by Mr. F. M. Rogers. The directors propose to change the name of the corporation to "The Western Electricity Supply Co., Ltd." The meeting was to be held on Wednesday last

Montevideo Telephone Co., Ltd.

Presiding at the annual meeting of this company (whose report was reviewed in our issue of November 25th, p. 917), on November 28th, Mr. F. Gill (acting chairman) said that the capital expenditure during the past year had been larger than usual. That was due to the opening of a new exchange at Pocitos, an outlying district where a demand for telephone service had arisen. In the early part of the current year the directors had been approached by the International Telephone and Telegraph Corporation regarding the acquisition of the company's shares. The offer was £2 per share provided that the holders of more than a half of the shares agreed to accept it. Practically all the shareholders did accept the offer, and the effect had been to stop dealings in the company's shares on the London Stock Exchange. The Corporation was allowing its offer to stand open for a time to give the few remaining shareholders an opportunity of accepting it. Subsequently Viscount St. Davids and Mr. J. G. Le Marchant resigned from the board, and their places were taken by Messrs. H. M. Pease and F. Gill. The report and accounts were adopted.

Mexican Power and Tramways.

The *Financial Times* reports that the annual meetings of the Mexican Light and Power Company, Ltd., and the Mexico Tramways Company were held in Toronto on November 28th. Mr. Miller Lash, K.C., chairman of the companies, presided at both meetings. The chairman said that so far the earnings had held up well during the current year, but no great improvement could be looked for so long as the present business depression continued. With regard to the Mexico Tramways Company, the chairman stated that the recent changes brought into effect in March of the present year—namely, the extension of the city zones, the reduction of fares and sale of weekly passes—had resulted in a moderate improvement in the earnings, and that the 20 new cars which were ordered during the year had all been delivered and were now in operation On the whole, the position of the tramways was improving to some extent. He added that he had just received advice from the company's representative in Mexico to the effect that the general outlook was much better than for some time past. In each case the annual meeting was followed by a special meeting increasing the number of directors of each company from 12 to 14.

Companies to be Struck off the Register.

The names of the undermentioned companies will be struck off the Register at the expiration of three months unless cause is shown to the contrary :—

Albion Electrical Co., Ltd.
Astro Intensifier, Ltd.
G.W.M. Electrical Co., Ltd.
Industrial Electrical, Ltd.
Oil Transformers, Ltd.
Western Counties Electric Railways & Tramways Co., Ltd.
West Yorks. Electrical Co., Ltd.
Wireless & Electric Co., Ltd.
X-Ray Tubes, Ltd.

Tube Investments, Ltd.

The revenue for the year ended October 31st was £109,616, and the addition of £113,075 brought forward makes £222,691. A dividend of 10 per cent. is recommended on the ordinary shares. The directors also propose to capitalise £181,376 of the reserves and distribute one new ordinary share for each three shares held; and to issue 181,376 ordinary shares to shareholders in the same proportion at 22s. 6d. each.

Hall Telephone Accessories, Ltd.

The report for the year ended August 31st last shows a net profit of £22,348, against £8,866 in the preceding year. It is proposed to pay a final dividend of 10 per cent., making 15 per cent. for the year, as compared with 10 per cent. for 1925-26. During the year the company acquired the business of the British Stamp and Ticket Automatic Delivery Co.

International Light and Power Co.

The report for the year ended June 30th last records an income of £79,396 and a profit of £37,236, to which is added £28,790 brought forward, making £66,026. From this £15,000 is written off in respect of loans to subsidiary companies, £2,500 is transferred to contingency reserve, the preference dividend is paid, and £27,268 is carried forward.

Manx Electric Railway Co.

The gross receipts for the year ended September 30th were £40,507, and the net receipts £10,866, to which was added £139 brought forward, making £11,005. After meeting debenture interest and sinking fund contribution £878 is carried forward. The number of passengers carried increased, but the gross receipts were smaller.

Bullers, Ltd.

The profit for the year ended July 31st last was £15,614, as compared with £3,557 in 1925-26. After adding the balance brought forward, there is £16,529 available, £6,460 of which is transferred to debenture sinking fund, and £2,568 carried forward. The improvement of the company's facilities for the testing of e.h.p. material is under consideration.

Amalgamated Wireless (Australasia), Ltd.

The Sydney Press reports that the directors have decided to postpone the holding of the annual general meeting "owing to important negotiations which the directors are conducting on behalf of the company."

Marconi's Wireless Telegraph Co., Ltd.

The directors announce that the report and balance sheet for the year ended December 31st, 1926, will be issued to shareholders shortly, and that it is hoped to hold the general meeting before Christmas.

S. Smith & Sons (Motor Accessories), Ltd.

The profit for the past year was £101,432 (against £73,336). The preferred ordinary dividend is raised from 7 to 14 per cent. and the deferred ordinary from *nil* to 25 per cent.

Brazilian Traction, Light and Power Co., Ltd.

A quarterly dividend of 7½ per cent. has been declared on the cumulative preference shares.

British Insulated Cables, Ltd.

An interim dividend of 2½ per cent. has been declared, as compared with 5 per cent. last year.

French Companies.

The *Compagnie des Etablissements Paz et Silva* reports net profits of 2,160,000 fr. for 1926-27 as against 934,000 fr. in the preceding year, and the dividend is raised from 9 fr. per share to 10 fr.

The *Société Industrielle des Téléphones* reports net profits of 10,139,000 fr. for 1926-27, as compared with 10,850,000 fr. in the previous year. The company proposes to pay a dividend of 40 fr. per old share, as against 50 fr. in the previous year, and 20 fr. per new share. The capital was increased from 36,000,000 fr. to 54,000,000 fr. during the financial year.

Stocks and Shares.

MONDAY EVENING.

STOCK Exchange conditions, as reflected in the price-lists which we publish, have recapitulated the features of the previous week. Brazilian Tractions have gone ahead in amazing manner, common and preferred showing double-figure rises. Cable stocks are flat, and the depression has spread into the shares of the construction-equipment group. Investment securities maintain a very firm front and most of the gilt-edged stocks are harder for choice. The Stock Exchange has entered upon the final settlement of the present year, and, after the pay-day on December 22nd, there is no other until three weeks later, on January 12th, 1928.

Electricity Supply Shares.

As will be seen by our share list, price changes in electricity supply securities, both home and foreign, have been few and far between, but in spite of this the usual steady business has taken place. Edmundsons at 45s. are better on rumours of a share bonus in the near future. To some people, this seems unlikely. The company is probably doing very well, but the present price, as previously suggested, would appear to discount the future for some little time to come. Urban ordinary came back to 35s. after touching 37s. 6d. A decline of 6d., to 25s. 6d., in Charing Cross ordinary, is balanced by an equal rise in "City Lights" to 29s. 3d. A considerable amount of business has taken place in Counties, without affecting the price on balance. Among the lesser known companies, Electrical Distribution of Yorkshire have been inquired for about 31s.; Chiswicks are 49s. ex. rights, and the new shares, with nothing paid, are 29s., the two classes thus being the same prices. As the new shares rank for a full final dividend for 1927, and for the moment pass free of stamp and fee, they are slightly the cheaper of the two.

In trust companies concerned with electricity, Beavers went 6d. better to 21s. and Spheres were wanted at 18s. The last report of the Bromley (Kent) Electric Light and Power Co. was issued during the week. The undertaking has been taken over by the local authorities as from April 1st last, and the company is about to be wound up. From the account, it would appear that the ordinary shares will receive something in the neighbourhood of £2 a share, which, all things considered, is very satisfactory. As most of the assets are now in the form of liquid cash, it should not be long before shareholders receive the major portion of their money.

Overseas Companies.

As regards overseas companies, Whitehall Electric Investment 7½ per cent. preference gained 3d. at a guinea bid, whereas the 6 per cent. 1st debenture stock is a point lower at 102. Perak River Hydro Electric 7 per cent. participating debenture has been steadily bought, and the price rose 2 points to 107. Of Indian companies, Calcuttas are a shade off 47s. 6d., but Madras Supply ordinary are unchanged; the 7 per cent.

debenture is higher at 101. Andhra Valley 7 per cent. debentures are also harder at 102¼. Mexican Light & Power Securities have all regained their drop of the previous week as a result of the cheerful proceedings at the annual meeting, details of which were cabled from Canada in the middle of the week. The common gained 4½, rising to 55: the preferred put on 3 to 76, the fives 2, at 78. British Columbia Electric Railway stocks were also strong spots. The preferred at 141½ and the deferred at 181½, both ex right, but cum dividend, are respectively 5 and 9 points to the good. A very large business has been done in the new deferred shares. The opening price was 13s. 6d., rising later to 15s. 3d., equal to 176¼ for the stock and, as the new deferred shares rank equally with the old stock in every respect, they are the better purchase of the two by some 2½ points, taking into consideration the fact that they are transferable, at present, free of stamp duty. The speeches of the chairman and the president at the annual general meeting held last Friday, made it clear that this concern has almost unlimited scope for expansion in British Columbia.

The Brazilian Traction Boom.

The "star turn" in the electric traction section is again Brazilian Traction, big business resulting in a rise of 11 points to 235 in the common and 12½ points to 196½ in the preferred. British Electric Traction has been without interest. Mexico Tramways common were a good market in sympathy with the Mexican Light & Power issues. At one time, Mexico Trams reached 26½, but reacted to 25½, a net gain of two points on the week. London Tramways were without interest. London Suburban and London United Trams preference remain unchanged at 8s., with London Suburban Traction ordinary lower at 2s. 9d. Business was done in Metropolitan Trams ordinary and preference at 6d. and 6s. respectively. Very few transactions take place in the shares of this company, as practically the whole share capital is held by the London and Suburban Traction Company. Lancashire United Transport and Power ordinary continued at 8s. 6d. in spite of the good traffics, and La Platas went back to 5s. Lisbon Trams were inquired for and, as a result, gained 1s. at 15s. 6d. Among out of the way concerns, Provincial Tramways £10 preference marked 4, and the £1 ordinary shares 4s. We understand that the Potteries Electric Traction Co., Ltd., have at last come to an agreement with the local authorities, by which the company will cease to operate the tramway system, and, in the future, concentrate attention upon the running of motor omnibuses of which it owns and operates a fairly large fleet.

Cable and Wireless.

Marconis followed up their gain of last week with a rise of 1/16 to 31s. 3d. The newspapers have been full of the conflicting claims of the two systems, submarine and radio, and the matter continues to arouse the keenest interest. Mr. Kellaway, of the Marconi Company, has stated that he sees no objection to co-operation, provided that the wireless workers are given a free hand. Investors in cable stocks and shares view the outlook with undisguised apprehension. Eastern ordinary stock has lost 5 points. Western Telegraphs are £1 down, Globe ordinary show a similar loss. Eastern Telegraph 3½ per cent. preference drooped to 61½ before hardening to 62½. The Anglo-American group fell into line with the rest. Wireless communication is expected to be established in the near future between this country and the United States. In consequence, Anglo-American preferred declined to 100. Commercial Cable 4 per cent. debenture has dropped to 72½. Direct Spanish have fallen to 7½. The débacle, it will be noticed, is very general. Canadian Marconis, which were 6s. 9d. a fortnight ago, have reversed these figures, American interests being substantial buyers of the shares.

Manufacturing Shares.

The slump in cable stocks is having a marked effect upon shares of the construction class. Telegraph Constructions are no less than £4 down at 25½. The heavy price of the shares, and the extreme narrowness of the market in them, render Telegraph Constructions peculiarly susceptible to repercussion from the cable stocks' flatness. British Insulated and Callenders have shed 5s.; Henleys are 1/16 down. Nor are electrical equipments exempt from a sympathetic heaviness. British Aluminium have improved to 46s. 6d., and Metropolitan-Vickers are better, at 30s. India Rubber shares recovered further, to 15s. The tendency of the market is uncertain, and the uncertainty has led to a little selling on behalf of the speculative division as well as on that of the investor.

Matters Miscellaneous.

Metropolitan Railway consolidated stock has hardened 1½, still being bought upon anticipation of favourable results from the greyhound racing popularity. The other Tube stocks and shares are quiet. Rubber shares have kept tolerably steady, though business in them shows a distinct disposition to dwindle. Armstrongs and Vickers have given way, the iron and steel group being dull as a whole. In this branch of industry there is a good deal of talk about possible amalgamations, complete or partial, between some of the giant companies engaged in the trade.

Share List of Electrical Companies.

	Nom. £	Dividend. 1925.	Dividend. 1926.	Price Dec. 5 1927.	Rise or fall.	Yield. p.c.
Home Electricity Companies.						
Bournemouth and Poole	1	14	14	58/9	+6d.	4 15 8
Brompton Ordinary	1	10	8¾	24/6	—	5 14 3
Charing Cross Ordinary	1	15	8½	25/6	−6d.	5 9 10
do. do. 4½ Pref.	1	4½	4½	17/6	—	5 2 10
Chelsea	1	12	8½	25/6	—	5 9 10
City of London	1	15	7½	29/3	+6d.	4 15 9
do. do. 6% Pref.	1	6	6	22/6	—	5 6 8
Clyde Valley	1	8	8	39/6	—	4 18 6
County of London	1	15	7½	28/6	—	4 18 3
do. do. 6% Pref.	1	6	6	28/-	—	5 4 4
Edmundson's Ordinary	1	8	10	45/-	+1/16	4 8 11
do. 7% Pref.	1	6	7	24/6	—	5 14 3
Elec. Supply Corporation	1	10	10	38 9	—	5 18 6
Kensington Ordinary	1	15	8	25/6	—	5 9 10
Lancs. Light and Power	1	7½	7½	27/-	—	5 11 1
London Electric	1	10	8½	24/6	—	5 14 3
do. do. 6% Pref.	5	6	6	5½	—	5 11 3
Metropolitan	1	11	8	30/-	—	4 13 4
do. 4½% Pref.	1	4½	4½	17/-	—	5 8 6
Midland Counties	1	6½	6	24/-	—	5 0 10
Newcastle-on-Tyne Ordinary	1	7	5	23/9	—	4 4 3
do. 5% Pref.	1	5	5	17/6	—	5 14 3
do. 7% Pref.	1	7	7	25/-	—	5 12 0
Notting Hill 6% Pref.	10	6	6	10½	—	5 11 7
North Met. Elec. 6% Pref.	1	6	6	22/6	—	5 6 8
St. James' and Pall Mall	5	17½	8	26/-	—	5 7 8
South London	1	15	8½	25/-	—	5 12 0
South Metropolitan Pref.	1	7	7	1½	—	6 8 0
Urban Ordinary	1	7	7	1¾	—	8 18 6
do. 6% Pref.	1	6	6	1⅛	—	5 18 0
Westminster Ordinary	1	15	8½	25/6	—	5 9 10
Whitehall Elec. Invst. 7½% Pref.	1	7½	7½	21/-	—	7 2 10
Yorkshire Elec.	1	8	8	32/-	—	5 0 0
Home Rails.						
Central London Ord. Assented	Stock	4	4	71	—	5 12 8
Metropolitan	,,	5	5	63½	+1½	4 14 6
do. District	,,	5½	5½	68½	—	5 10 3
Underground Electric	£1	Nil	1½	19/-	—	1 11 7
do. do. Income	Bonds	6	6	105	—	5 14 3
Telegraphs and Telephones.						
Anglo-Am. Tel. Pref.	Stock	6	6	110	−3½	6 0 0
do. Def.	,,	1½	1½	2 2	—	6 1 3
Automatic Telephone	1	8	10	48/-	—	4 3 4
Chili Telephone	5	5	5	7⅞	—	3 16 3
Eastern Extension	10	10	10	15½	—	6 9 0
Eastern Tel. Ord.	Stock	10	10	1 0	−5	6 13 4
Globe Tel. and T. Ord.	10	10	10	15½	−1	6 9 0
do. do. Pref.	10	6	6	10⅝	—	5 10 4
Great Northern Tel.	10	20	20	37½	—	5 6 8
Indo-European	25	8½	10	40	—	*6 5 0
Marconi	1	Nil	Nil	31/3	+1/16	... ...
Marconi-Marine	1	7½	8¾	30/-	—	5 16 8
Oriental Telephone Ord.	1	12	12	51/3	—	*4 13 6
United R. Plate Tel.	5	8	8	9½	—	*4 1 5
Western Telegraph	10	10	10	14½	−1	*5 17 11
Home and Foreign Trams, &c.						
Anglo-Arg. Trams First Pref.	5	5½	5½	8½	—	7 17 2
do. do. 2nd Pref.	5	6	6	8⅝	—	8 8 6
do. do. 5% Deb.	Stock	5	5	74½	—	6 14 8
British Electric Traction Def. Ord.	,,	8	8	500	—	... ...
do. do. 8% Pref. Ord.	,,	8	8	123½	—	6 9 7
Brazil Traction	100	5	6	23⅛	+11	2 11 1
Brit. Columbia Elec. Rly. Pos.	Stock	5	5	99⅛	—	5 6 11
do. do. Preferred	...	6¼	6¼	141¼	+⅛	4 8 4
do. do. Deferred	,,		5	181½	+9	*4 8 2
do. do. Deb.	,,	4¼	4¼	80½	—	5 5 11
London & Sub. Trac. 5% Pref.	1	Nil	Nil	8/-	—	... ...
London United Tram. Deb.	Stock	4	4	57½	—	6 19 2
Mexico Trams, 5% Bonds	—	5	5	72	—	6 18 11
Mexican Light Common	100	Nil	Nil	55	+4¼	Nil
do. Pref.	100	Nil	Nil	76	+3	Nil
do. 1st Bonds	—	5	5	79½	+3	6 7 5
Yorkshire (West Riding)	1	6	—	7/6	—	... ..
Manufacturing Companies.						
Babcock & Wilcox		18	18	8	—	4 6 8
British Aluminium Ord.	1	12½	10	46/6	+1/-	4 6 0
British Elec. Transformer Pref.	1	Nil	7	18/9	—	7 12 6
British Insulated Ord.	1	15	15	3 5/16	−¼	3 16 3
Brush Ord.	1	10	10	28/9	—	6 16 4
Callenders	1	15	15	3 5/16	−¼	3 16 3
do. 6½% Pref.	1	6½	6½	23/9	—	5 9 6
Crompton Parkinson Pref. Ord.	1	Nil	Nil	16/-	—	... ...
Edison-Swan	4/-	10	10	10/-	—	4 0 0
do. 6% Deb.	Stock	5	5	90	—	5 11 1
Electric Construction	1	10	7½	28/9	—	5 4 4
Enfield Cable Pref.	1	7½	7½	25/-	—	6 0 0
English Electric	1	Nil	Nil	9/-	− 1/-	... ...
do. do. Pref.	1	8	—	12/-	—	... ...
Gen. Elec. Pref.	1	6½	6½	24/6	—	5 6 1
do. Ord.	1	7½	7½	34/-	—	4 6 1
Henley	1	20	25	105/-	−1/3	4 15 3
do. 4½% Pref.	5	4½	4½	4½	—	5 6 0
India-Rubber	1	5	—	15/-	+1/3	... ...
Johnson & Phillips	1	17½	12½	49 3	-	5 1 8
Met.-Vickers Ord.	1	8	8	30/-	+1/3	5 6 8
do. Pref.	2	8	8	2⅝	—	6 4 8
Siemens Ord.	1	7	7½	31/3	—	4 16 0
Telegraph Construction	12	10	10	25½	−4	*4 14 1

* Dividends paid free of Income Tax.

Indian Electrical Imports in 1926-1927.

THE following are the figures of the electrical imports into India during the twelve months ended March 31st, 1927. In accordance with our usual practice the comparative figures for 1925-26 are also shown and the increase or decrease for each item :—

	1925-26. Thou. Rs.	1926-27. Thou. Rs.	Inc. or dec. Thou. Rs.
Electrical machinery—			
Control and switchgear ...	3,640	3,238	– 402
Generators, alternators and dynamos	4,193	4,942	+ 749
Motors	3,459	2,935	– 524
Transformers	1,849	2,304	+ 455
Turbo-generator sets	2,760	771	–1,989
Other electrical machinery ...	6,333	8,744	+2,411
Total	22,234	22,934	+ 700
From United Kingdom	18,394	18,605	+ 211
„ Germany	936	1,095	+ 159
„ United States	1,973	2,266	+ 293
„ Other countries	931	968	+ 37
Electric fans and parts thereof—			
Total	2,825	3,187	+ 362
From United Kingdom	1,617	2,121	+ 504
„ Italy	635	602	– 33
„ United States	205	149	– 56
Electric wires and cables, rubber insulated—			
Total	3,715	3.043	– 672
From United Kingdom	3,379	2,839	– 540
„ Germany	202	121	– 81
„ Netherlands	55	24	– 31
„ United States	24	33	+ 9
Insulations other than rubber—			
Total	2,286	2,908	+ 622
From United Kingdom	2,109	2,594	+ 485
Telegraph and telephone wires and cables—			
Total	163	97	– 66
From United Kingdom	162	84	– 78
Bare copper wire (electrolytic)—			
Total	1,538	2,087	+ 549
From United Kingdom	1,158	1,579	+ 421
All electric wires and cables detailed above—			
Total	7,701	8,135	+ 434
From United Kingdom	6,808	7,096	+ 288
„ Germany	476	383	– 93
„ Netherlands	192	165	– 27
„ Japan	85	5	– 80
„ United States	29	404	+ 375
Telegraph and telephone instruments and apparatus—			
Total	769	477	– 292
From United Kingdom	702	402	– 300
Electric glow lamps—			
Total	2,001	2,065	+ 64
From United Kingdom	791	788	– 3
„ Germany	147	135	– 12
„ Netherlands	565	768	+ 203
Electric lamps, other sorts—			
Total	474	1,099	+ 625
From United Kingdom	46	62	+ 16
„ Germany	52	69	+ 17
„ United States	349	905	+ 556
Batteries—			
Total	889	1,017	+ 128
From United Kingdom	430	396	– 34
„ United States	216	432	+ 216
Carbons, electric (including furnace electrodes)—			
Total, largely from U.K. ...	63	64	+ 1
Accumulators (including parts)—			
Total	1,216	1,670	+ 454
From United Kingdom	902	1,324	+ 422
„ United States	89	104	+ 15
Electric lighting accessories and fittings (including switches)—			
Total	1,602	1,506	– 96
From United Kingdom	941	1,092	+ 151
„ Germany	186	273	+ 87
„ United States	428	93	– 335
Electrical instruments (other than telegraphic and telephonic meters)—			
Total	630	551	– 79
From United Kingdom	462	459	– 3
„ Germany	93	48	– 45
Electrical instruments (other sorts)—			
Total	403	280	– 123
Electromedical apparatus—			
Total	284	176	– 108
Switchboards—			
Total	321	409	+ 88
From United Kingdom	305	395	+ 90
Unenumerated electrical goods—			
Total	2,966	3,625	+ 659
From United Kingdom	1,810	2,273	+ 463
„ Germany	489	551	+ 62
„ Japan	163	108	– 55
„ United States	376	584	+ 208
All electrical instruments and apparatus—			
Total	22,500	25,190	+2,690
From United Kingdom	15,179	16,897	+1,718
„ Germany	2,220	2,196	– 24
„ Netherlands	816	1,029	+ 213
„ Italy	694	684	– 10
„ Japan	313	214	– 99
„ United States	2,271	3,332	+1,061

The German Cable Manufacturing Industry.

A Comparison of Pre-war and Post-war Conditions.

SINCE the end of the war various additions have been made to the German cable manufacturing industry and the number of high- and low-pressure cable factories is now 22 as compared with 14 in 1913. At the same time large extensions have been made at the factories which were already in existence in 1913, so that their productive capacity has been increased. It is pointed out by the Berlin correspondent of the *Frankfurter Zeitung* that no exact figures are available concerning the present production as the works almost entirely refrain from issuing statistics on the subject. In trade circles it is calculated that about 50 per cent. of the production was exported before the war; thus as these particular exports represented 60,000,000 marks in 1913 the value of the output would be about 120,000,000 marks, whereas the inland turnover now is said to exceed that in 1913 by about 50 to 60 per cent., with exports remaining statistically with but little change. Thus the production of cables has not increased so much as that of electrotechnical products as a whole, since at the recent Geneva conference the value of the total German output of electrical products was estimated at 2,100,000,000 marks in 1925, as compared with 1,300,000,000 marks in 1913. It appears also that even under the prevailing favourable conditions, the productive capacity is not being fully utilised on all hands. Nevertheless, it is reported that schemes for the erection of new cable factories are pending.

Sale prices are said to be scarcely as high as, or only a little higher than, in 1913 in so far as they are comparable as a consequence of the technical improvements which have taken place, although raw materials are dearer and wages, social burdens and taxes are much greater. The question as to whether profits have become less, as is asserted in some quarters, is left an open matter. That excessive prices cannot be gained is contradicted by the cable factories which stand outside the High and Low Pressure Cable Syndicate, which has long been in existence and primarily regulates prices. The syndicate also fixes the allotted production, but the rules in this respect are not rigid. An excess of the quotas is not prohibited and is only subject to a small penalty. It is left free to the firms to get orders, but quoting under the fixed prices only takes place to a slight extent. Excessive prices are also prevented by relatively low German import duties. As compared with other industries, the period for the payment of accounts is relatively short. The following table gives the value of the exports in millions of marks before the war and in the post-war period, the figures being quoted from the statistics of the Central Union of the German Electrical Industry :—

GERMAN ELECTRICAL EXPORTS IN MILLIONS OF MARKS.

	1913.	1925.	1926.	1927.*
Total exports	330.5	356.3	390.8	395.8†
Cables and insulated wires	61.0	56.4	75.6	59.9‡
Machinery	64.4	51.8	54.7	67.1
Glow lamps	48.1	26.8	22.5	21.7
Telegraph and telephone apparatus	13.3	24.5	35.4	26.4
Switching apparatus, &c. ...	74.0	77.1	80.2	90.3
Measuring and recording apparatus	24.2	31.5	30.6	31.7
Carbons	12.1	9.0	10.9	10.9

* The total results for 1927 are estimated on the basis of the exports in the first eight months.
† Including deliveries on reparation account, totalling 11.81 million marks.
‡ Including reparation deliveries of 1,000,000 marks.

Some interest will probably be manifested in the destination of the exports of cables and insulated conductors, as is shown in the second table in millions of marks :—

EXPORTS OF CABLES AND INSULATED WIRES IN MILLIONS OF MARKS.

Destination.	1913.	1925.	1926.	1927.*
Total	61.0	56.4	75.6†	59.9
Belgium	5.9	1.2	1.1	1.6
Great Britain	7.2	5.2	6.1	5.7
Holland	6.4	12.9	14.4	12.0
Norway	4.2	3.2	1.4	0.9
Denmark	2.0	3.0	0.9	0.7
Italy	1.3	2.8	0.7	0.5
Japan	3.3	0.2	2.0	—
Dutch Indies	2.3	0.9	1.6	1.8
Argentina	7.6	4.6	6.8	6.9
Uruguay	0.6	1.3	1.7	1.4

* Estimated on the basis of the exports in the first eight months.
† Including 16,000,000 marks for submarine cables.

After pointing out the loss of business with certain countries as indicated in the table, the correspondent states that normal export business is very difficult. As many as 20 competitors from all countries often contest a single order so that German export prices have fallen to 15 per cent. below the home prices. Thus before the war no cable factories existed in Holland and Norway; to-day there are several. In Sweden there was only one, but now there are three. The Italian market has almost been closed to German cables, while at the same time Italian cable makers are keen competitors in the Balkans and the Mediterranean countries. France and Belgium are also endeavouring to advance in the world markets, while Russia almost satisfies her own requirements from the former German factories; and the Poles are now seeking to render themselves independent by the development of the Cracow works of the Pressburg Cable Works Company.

The correspondent proceeds to refer to the preference given to national products in England and her Dominions, &c., and states that the only markets which can be satisfactorily worked are Japan and South America, although the financial penetration in the latter market of North America and the advent of French competition are factors which have to be taken into account.

New Electrical Proposals for Parliament to Consider.

WE publish below a list of proposals that will come forward in the next session of Parliament (1928). Readers who are desirous of obtaining further information will find the notices published in full in the *London Gazette* for November 22nd and 25th.

(a) Electric Light and Power.

York Town and Blackwater Gas and Electricity Co.—Further powers in connection with the electricity undertaking, power to provide showrooms, further financial powers, power to change name of company, &c.

North Metropolitan Electric Power Supply (Consolidation).—Powers to consolidate the North Metropolitan Electric Power Supply Acts, 1900-1927, including the repeal of those Acts and the re-enactment thereof with modifications, alterations, &c., redefining of limits of supply, special area, special district, powers, &c.

Wessex Electricity Co.—Extension of limits of supply to include parts of the administrative counties of Cornwall, Devon, Dorset, Gloucester, Southampton and Wilts; extension of meaning of "the area of supply" in Wessex Electricity Act, 1927, financial provisions, &c.

Cleveland and Durham County Electric Power Co.—Re-definition and re description of the area in which the company is entitled to supply electricity under its Act of 1901, extension of the area of supply to include the whole of the administrative county of the East Riding of Yorkshire, the city, county and county borough of Kingston-upon-Hull, the portion of the administrative county of the North Riding of Yorkshire not included in the existing area, the city of Ripon, the borough of Harrogate, the urban and rural districts of Knaresborough, and the rural districts of Ripon, Pateley Bridge and Great Ouseburn, the city, county and county borough of York and portions of the rural districts of Weardale and Barnard Castle, additional powers and general provisions relating to the company and its undertaking, further financial provisions, &c.

Shropshire, Worcestershire and Staffordshire Electric Power Co.—Extension of area of supply to include the borough of Tewkesbury, the urban district of Stow-in-the-Wold, the rural districts of Marston, Sicca and Pebworth, and parts of the rural districts of Tewkesbury, Winchcomb, Campden and Stow-in-the-Wold; the rural districts of Alcester, Brailes and Farnborough, and part of the rural district of Stratford-on-Avon, the borough and the rural district of Banbury, and part of the rural district of Middleton Cheney, general powers of distribution in certain portions of the proposed extended area of supply, further financial provisions, &c.

Accrington Corporation.—Extension of the area of supply of electricity to include the parish of Huncoat, to provide, equip and work trolley vehicles, to abandon certain Corporation tramways; further powers in connection with the electricity undertaking.

Stoke-on-Trent.—Further powers with respect to the Council's electricity undertaking, further financial powers.

Lincolnshire Power Co., Ltd.—Powers for the generation, distribution and supply of electricity for all purposes within the county of Lincoln, including parts of Holland, Kesteven and Lindsey and the county boroughs comprised therein, &c.

Weald Electricity Supply Co., Ltd.—Powers to purchase and acquire the electricity undertaking of the Crowborough District Gas & Electricity Co. Extension of area of supply, financial powers, &c.

Stretford and District Electricity Board.—Application by the Stretford Urban District Council and the Barton and Urmston Electricity Board to incorporate a joint board consisting of the Stretford Council, the Urmston District Council, and the Barton-upon-Irwell Rural District Council for the purposes of acquiring the electricity undertaking of the Stretford Council and the undertaking of the Barton Board, and of supplying electricity within the urban districts of Stretford and Urmston and the parishes of Davyhulme, Flixton and Barton Moss, in the rural district of Barton-upon-Irwell, financial powers, &c.

Llandudno Urban District Council.—Further powers in connection with the electricity undertaking, powers to run omnibuses within the district, &c.

Caerphilly Urban District Council.—Further powers with respect to the electricity undertaking, extension of powers in regard to the provision of running of omnibuses within the district, &c., additional borrowing powers, &c.

Hastings Corporation.—Further powers with respect to the electricity undertaking, &c.

Blackpool.—Extension of the county borough to include the urban districts of Poulton-le-Fylde and Thornton Cleveleys and a portion of the Fylde rural district, extension of the limits of the Corporation for the supply of electricity and the transfer to it of the electricity undertaking in the added areas, further financial powers, &c.

(b) Electric Tramways, Motor-'buses and Trolley Vehicles.

Sheffield Corporation.—Powers to construct additional tramways within the city and in the parish of Orgreave in the rural district of Rotherham, further financial provisions, &c.

London County Council.—Enlargement of tramway subway between Southampton Row and the Victoria Embankment, and reconstruction of the tramways in the subway and on the Victoria Embankment, &c.

Nottinghamshire and Derbyshire Tramways Co.—Powers to provide and run trolley vehicles in the borough of Ilkeston and the urban districts of Ripley and Heanor in the county of Derby and in the urban district of Eastwood and the rural district of Basford in the county of Nottingham, in which the company's tramways are situate, and along certain routes in the county of Derby, &c.

Cleethorpes Urban District Council.—Powers to purchase and work, all or any of the tramways within the urban district of Cleethorpes belonging to the Great Grimsby Street Tramways Co., powers to use trolley vehicles within the district, further powers with regard to the electricity undertaking, &c.

Rotherham Corporation.—Powers to construct new tramways, further provisions as to tramways, trolley vehicles and omnibuses, provision of works and conveniences for working tramways and trolley vehicles and the supply of electricity therefor, the discontinuance of tramways along routes authorised for trolley vehicles, further power with regard to trolley vehicles, further provisions as to the Corporation's electricity undertaking, financial provisions, &c.

Wolverhampton Corporation.—Powers to provide and run trolley vehicles within and beyond the borough, powers to purchase from the Wolverhampton District Electric Tramways, Ltd., the South Staffordshire Tramways Co., the South Staffordshire Tramways (Lessee) Co., Ltd., and the British Electric Traction Co., Ltd., certain tramways and light railways, abandonment and discontinuance of certain tramways and light railways, extension of the area of supply of electricity, further powers with regard to the electricity undertaking, financial powers, &c.

Southampton Corporation.—Construction of new tramways in Burgess Road between The Avenue and Portswood Road, &c.

Poole Corporation.—Powers to abandon or discontinue temporarily or permanently certain light railways and to provide and run motor omnibuses.

Gloucester Corporation.—Provision, equipment and working of trolley vehicles within the city, abandonment or discontinuance of certain light railways.

Exeter Corporation.—Construction of new tramways, powers to run omnibuses, further provision with regard to the electricity undertaking, further financial powers, &c.

Bradford Corporation.—Powers to construct new tramways, reconstruction of tramways in the borough of Brighouse, powers to purchase the Halifax tramways, abandonment of certain tramways, further powers in connection with the electricity undertaking, powers to run omnibuses outside the city, &c.

The Institute of Fuel.

Proceedings at the First Annual Meeting of the Institute.

(*Concluded from page 944.*)

Operating Experiences with 1,300-lb. Steam Pressure.

By JOHN ANDERSON.

(*Abstract.*)

THE paper is a record of the actual operating experiences with a 240,000-lb. water-tube steam boiler installed at the Lakeside power station, Milwaukee, U.S.A., and generating steam at a pressure of 1,300 lb. per sq. in. The period covered is eleven months and the boiler was in service for 57 per cent. of this period, including one continuous run at full capacity for 50 days.

There have been experienced major troubles confined almost wholly to tube failures from scale formation, and tube corrosion troubles. No difficulties appear to have been experienced with the piping or mountings. For h.p. service it is positively necessary to provide nearly scale-free make-up, because 150 deg. F. higher water temperature than in 300-lb. boilers exists, and there are higher metal stresses equivalent to an additional 150 deg. F. higher tube temperature.

It is also necessary to maintain an appreciable caustic alkalinity, and to reduce the oxygen in the feed water to below 0.1 cm^3 per litre, in order to prevent corrosion in h.p. boilers fed with evaporated make-up.

The first suggestion of tube trouble occurred after 880 hours' operation, when a hissing noise was heard in the furnace; a front fin tube near the east wall had bulged and punctured near its upper extremity, presumably where the highest heat transfer occurred due to nearness to the burner tips. Cutting this tube across revealed a uniform coating of scale 1/32 in. thick over the side exposed to the furnace, except at the bulge, where scale filled nearly the entire extruded section. Many such bulges were experienced, but there was no splitting of tubes. The scale deposits were ultimately found to be due to about two per cent. condenser leakage into the feed water.

After 726 hours' operation on the next period, making 1,600 hours' total since new, ten more fin tubes had to be replaced because of blisters or excessive blowing, and these troubles, as previously, were confined to tubes near the side walls. During this stoppage 28 boiler tubes were removed because of blistering and warping. The latter tubes were exposed to the maximum radiation and convection heat. Calculations indicated that 900 deg. F. tube temperature could occur under operating conditions with scale of 1/16th-in. thickness. Conclusions from analytical work and actual experience show that a maximum scale thickness of 1/32 in. can be tolerated and that 1/16 in. means a tube failure. The cleaner inside boiler surface which had been maintained brought new troubles due to corrosion, and the deposits now found in the tubes were composed of black iron oxide. In the next period of operation tri-sodium phosphate was used in the feed water and trials were made with different degrees of concentration. Investigations at this period indicated that reducing the oxygen content to 0.1 cm^3 per litre or lower was positively necessary. The boiler water concentration resulted in deposits in the first sections of the superheater and the latter half of the turbine, the reason being that the melting point of sodium-hydrate occurs at 604 deg. F. The use of baffles in the top drums, and decrease of concentration of solids in the boiler water, effected a decrease in the carry-over to such a point that deposits on the turbine blading were no longer cumulative.

Discussion.

Mr. W. H. PATCHELL, who had introduced Mr. Anderson's paper, opened the discussion by giving the following further information about the boiler referred to in it. He said that in 1920 the standard capacity of the boilers in use at Lakeside was 72,000 lb. per hour, but in 1924 this had been increased to 112,500 lb. per hour, whereas the boiler described in the paper had a capacity of 240,000 lb. per hour. It was a three-drum Stirling boiler built for a pressure of 1,390 lb., and it had 38,530 sq. ft. heating surface, the tubes being of 3 inches outside diameter. The side walls of the furnace were formed with a radiant-heat superheater of 930 sq. ft., the rear walls of the reheater had 937 sq. ft. heating surface, the front wall of the furnace was made of fin tubes and had an evaporative surface of 458 sq. ft. The air-heater plate tube heated to 660 deg. F., the water screen in the bottom had a surface of 532 sq. ft., and the riser tubes a surface of 552 sq. ft. The high-pressure machine used for compounding was a 20-stage impulse turbine, the wheels being integral with the shaft, which was made from a nickel steel forging. The average transfer from the radiant heat was 4,500 B.th.u. per sq. ft. per hour. The CO_2 was 16½ per cent., but Mr. Anderson had run for a short time at 17¼ per cent.

Mr. F. H. ROSENCRANTS, speaking with reference to the permissible temperature of preheated air which might be utilised with stoker firing, said that most of the discussions on this subject hitherto had been with reference to the maintenance factor as applying to stokers and furnaces. It had been learned recently, however, that the temperature of preheated air which could be utilised successfully might also be limited from purely a combustion point of view. In the present case, for instance, it had been found that up to a certain rating with the stoker, combustion conditions were quite satisfactory, but beyond this rating the fire at the feed gate began to break up and in a very short time the fuel bed was in a most unsatisfactory condition. The air temperature was of the order of 500 deg. F. and the grate temperature as it passed under the coal hopper, was also in the neighbourhood of 500 deg. F. During a period of experimenting to solve this problem it was suggested that the grate be cooled before it passed back into the furnace and as a temporary expedient a spray of water was applied to the grate as it passed over the sprocket. The result was indeed remarkable: immediately this was done, a perfect fire issued from the feed gate in a straight line and combustion conditions were excellent. An unsatisfactory condition again developed immediately the spray was shut off. The same thing had been tried with stokers of different makes, always with the same result. It was not known yet, however, whether the same action would take place with all kinds of coals. With the progress in perfecting stoker design he believed that much higher temperatures than were commonly in use might successfully be adopted. The successful handling of stoker riddlings was also a point to be carefully considered, since with high air temperature any considerable accumulation of riddlings in the air compartments became a menace as regarded spontaneous combustion. The furnace would require some positive means for cooling the side wall, and water cooling must be applied with discretion. The arch, too, demanded some consideration and water circulation might be effective but, at the same time, it might prove a delicate design. The use of preheated air in a pulverised-fuel furnace with refractory walls was practically suicidal.

Mr. HERBERT HUMPHREY (consulting engineer, Imperial Chemical Industries, Ltd.), said he had been to Milwaukee to see the plant described in the paper, and added that when he went into the matter of high-pressure steam for the purposes of his group of companies he came to the conclusion that he would not be justified in going to a pressure higher than 450 lb., for the reason that the conditions were not those of a central power station. He regarded the matter solely from an economical and £ s. d. point of view. However, he finally suggested a pressure of 550 lb. in order to provide a margin for the future. More recently he had had to assist in coming to a decision in connection with the installation of another large boiler, and the pressure had gone up to 750 lb. The reason for this was not that the original decision was wrong, but because of the advances that had been made since. It appeared that the extra capital cost would work out at about 8 per cent. on the total installation and, moreover, the tendency had been for the prices of these high-pressure installations to come down.

Mr. THOMAS ROLES (electrical engineer, Bradford Corporation) said that this was the first paper giving definite information with regard to operating troubles with high-pressure steam plants. On the question of the cost of high-pressure boilers, we did not yet know what this was going to be because the makers had not had time to find out their actual costs. It appeared that there would be a considerable increase in cost above 500 lb. pressure because of the necessity of using forged steel drums. Speaking generally, he said that unless a power station was operating in a district where the price of coal was very high, he was doubtful whether it would pay to go beyond a pressure of 800 lb. At Bradford it was thought better to go for 1,100 lb. now because if he extended the plant he could drop to 800 lb. if necessary. When an American engineer met with troubles he did not hesitate to let others know, but in this country engineers were too much inclined to keep their troubles to themselves and thus nobody else got the benefit of the steps taken to overcome them. The North Tees station had been referred to as the "hush hush" station in America; this was running ten years ago as a high-pressure station, and it would have been better for the development of the use of high-pressure steam had more information been published with regard to that station.

Mr. J. P. CHITTENDEN also thanked the author for his frankness in giving details of his troubles with his high-pressure plant. The Milwaukee plant could be described as a superposed plant, *i.e.*, a high-pressure plant working in conjunction with a normal-pressure plant, and this was one of the most interesting problems in high-pressure steam progress. This line of development would be the means of giving a new lease of life to many stations in this country, and it would also be the means of obtaining higher thermal efficiencies in a much cheaper manner than by putting down large new stations.

Mr. JOHN BRUCE (Barking power station) said the troubles experienced by Mr. Anderson with feed water were exactly similar to those which had been experienced in his station.

These troubles, however, had now been overcome and with a low oxygen content, from 0.2 to 0.5, corrosion did not take place.

Dr. T. Barratt said that the measure of success obtained by Mr. Anderson was indicated by the statement in the paper that an order for an additional 1,300-lb. boiler had been placed. Referring to the fact that the author, in discussing the effect of scale, had assumed that the thermal resistance of scale was 7½ times that of metal, Dr. Barratt said the only authentic figures he could find on this question made the thermal resistance of scale 40 to 125 times that of iron.

Mr. Patchell, in winding up the discussion, said he would not reply to the remarks that had been made because that was Mr. Anderson's task. On the question of prices, it was quite true that once they got to pressures which involved the use of forged drums, prices increased very considerably. The boiler-makers got practically what they could, knowing the prospective user could not get what he wanted anywhere else. Later on, however, prices would undoubtedly fall to a more commercial level.

Dr. J. A. Lessing, who presided during this discussion, showed some lantern slides illustrating the actual plant at Milwaukee, and mentioned that Mr. Anderson was also a pioneer in several other directions, one of which was powdered fuel firing.

Preheated Air for Boiler Furnaces.

By P. H. N. Ulander.

(Abstract.)

During the last decade one of the most interesting developments in the generation of steam for the production of electrical energy has been the increase in the application of air preheaters for the aiding of combustion in the boiler furnace, and for the reduction of flue-gas losses.

The change has largely been the result of economic pressure, for since the end of the war the tendency in the majority of large boiler installations has been towards an increase in ratings, coupled with the use of higher steam pressures and temperatures. Higher steam pressures naturally mean increased flue-gas temperatures, with consequently larger potential heat losses, and, in addition, the increase in the use of bled steam for feed heating has helped to make the task of the economiser more onerous. If there were no other device for recovering the heat in the flue gases other than the economiser, then the advantages of higher boiler ratings and bleeding would be largely lost owing to the increase in size, weight, and cost of this equipment, but the air preheater is capable of preventing the taking of such a retrograde step.

Owing to the relatively low price of the heating surface of the economiser, when compared with that of the boiler, the installation of a small economiser is frequently advantageous, but for higher boiler efficiencies, in those cases where the load factor and cost of fuel merit it, the addition of an air preheater is desirable and frequently essential. This fact will become more apparent in the future with the inevitable further increase of boiler ratings and the use of bled steam for feed heating. Whilst it is impossible to generalise, it may be suggested that the tendency of the future will be for an increasing number of air preheaters to be installed in connection with economisers of decreasing size. Moreover, it is fairly safe to assume that the trend of development will be towards an increase in the exit temperature of the flue gases from the boiler, and with the collateral rise in feed temperatures the installation of an air preheater of high thermal efficiency will be essential.

In addition to its value in this field, the air preheater is finding an increased use for the aiding of the combustion of low-grade fuels, especially those containing a large percentage of free moisture.

Air preheaters are developing along two distinct lines, namely, the regenerative and recuperative types, and the relative merits of each of these types are now known. The prejudice against the use of highly preheated air on account of, in some cases, the increased cost of maintenance of furnace brickwork and stokers is mainly due to lack of proper appreciation of some of the problems involved. If due and proper care be taken in the design of furnaces, arches and stokers, then no trouble need be expected with comparatively high air temperatures, as proved by practical experience with various types of installations over a period of years.

In short it may be said that the air preheater enables a reduction to be made in the capital cost of the complete steam generating unit and in the cost of generating the steam itself. Air preheating and the preheaters themselves have passed out of the experimental stage, and there is now no valid reason why engineers should view their installation with apprehension.

Measurement of Steam Flow in Works Practice.

By H. C. Armstrong, A.M.Inst.C.E., and T. Nordenson.

(Abstract.)

It is often impossible or difficult without direct steam flow metering to ascertain with certainty the actual steam losses in the plant, or to find out its real efficiency with regard to the steam consumption.

The type of apparatus that, according to the authors' experience, fulfils all the requirements is the simple throttle orifice diaphragm meter, with "slip-in orifice." In this apparatus an obstacle, usually in the shape of a thin diaphragm or "throttle plate," with a central hole, is introduced into the steam pipe where the flow is to be measured. The speed of the steam flowing becomes suddenly increased at the reduced section, which entails a pressure drop between the space in the pipe immediately in front of the diaphragm and that immediately behind it.

If the "differential pressure," and the pressure and temperature of the steam are measured, it becomes possible to calculate the velocity of the steam through the orifice. Further, the internal areas of the pipe and of the orifice are known, as well as the specific gravity of the steam. From these data the quantity of steam passing through the orifice can be calculated.

Hitherto the insertion of the orifice fittings supplied in conjunction with many meters has necessitated drilling the pipes and welding bosses on, or excessive "springing" of, the pipes to insert a more or less elaborate and expensive fitting. A very simple apparatus which satisfies the demand of the works engineer for simplicity consists of a plain ring, about a half-inch thick, with the internal diameter the same as that of the pipe and external diameter such that the ring fits inside the bolts between the flanges. The only alteration necessary to the pipe is that slightly longer flange bolts are required. Brazed or silver-soldered to the ring are two short lengths of h.p. copper pipe, with standard cocks, in such a way that they are open to the steam flow on either side of the diaphragm plate. Cooling coils are provided.

The arrangement possesses the advantages of extreme portability required when measuring steam flow in works practice. The fitting can be made in any workshop and fitted in any steam pipe in a very short time with the minimum of interference in the shop working, no drilling of pipes or welding of bosses being required.

The differential pressure head is measured by means of a manometer, or with a steam meter of the ordinary type. By means of a series of charts it is possible to read off the correct size of orifice plate for any flow in a pipe of given size, and also to convert the differential pressure head, $p_1 - p_2$, into direct-flow figures without the intervention of elaborate calculations. These charts, which have been translated into British terms by the authors, are taken from the works of Mr. Matts Backstrom, a Swedish engineer, a translation of which forms a part of the paper. Charts showing the coefficients to be employed with various orifice diameter ratios are also included.

Annual Dinner.

The annual dinner of the Institute was held at the Great Central Hotel, Marylebone, on November 23rd, when the Rt. Hon. Sir Alfred Mond, Bart., M.P., president of the Institute, took the chair, and about 300 members and visitors were seated.

Sir Andrew Duncan, LL.B., chairman, Central Electricity Board, proposed "The Institute of Fuel." He said that the Institute had been most opportunely formed, for never had there been a time when industry was faced with such perplexing problems as the present. Industry was calling out for relief from the municipal and Governmental activities which were conducted along wasteful lines. In this connection he thought that in the future there would be a permanently added burden to industrial costs, for which industry must find some other means of providing compensation. It was in that direction that the Institute could play an important part. Industrial peace could make an enormous contribution to the problems of industry.

Sir A. Mond, in reply, pointed out that only by reducing the costs of production could a higher standard of living be obtained. He did not regard the present trade position as depressing, but we could not go on manufacturing or selling abroad some products which used to be sold. In many countries a substitute for coal had been found in oil or hydro-electric power. We must turn our attention to the things which the world wanted. He would back the British workers against those of any other country.

Mr. Frank Hodges proposed "The Guests," and referring to research asked firms closely interested in the promotion of scientific objects to lend their weight and their money to the work of solving the almost unlimited problems of fuel production and utilisation, and to provide not an Institute on paper but an actual physical Institute with its own building, its own laboratories, and its own libraries which would be open to all scientists. If ever there was a time when it was necessary to make a special effort to provide money for research, it was in times of trade depression, because that was the only means by which we could struggle out of that depression.

Engineer Vice-Admiral Sir R. B. Dixon (Engineer-in-Chief to the Navy) replied to the toast, and said that even in these days of strict economy the fuel consumption of the Fleet and Naval establishments was about 750,000 tons of oil and 500,000 tons of coal per annum; therefore any means by which fuel could be economised would be welcomed by the Navy.

The Hon. W. C. Angwin (Agent-General for Western Australia) also replied, and referred to the great development taking place in research in the Mines Department in Western Australia.

"The President" was proposed by Sir Hugo Hirst, Bart., chairman, General Electric Co., Ltd., to which Sir Alfred Mond made a suitable reply.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this Section.

A Trailing-Cable Drum.

The following particulars relate to a trailing-cable drum, fig. 1, which has recently been produced by the DALYTE ELECTRICAL CO., West Row, North Kensington, W.10. The equipment has been expressly designed for conveying current to travelling cranes and other moving machinery where fixed conductors cannot be accommodated. It is of simple and

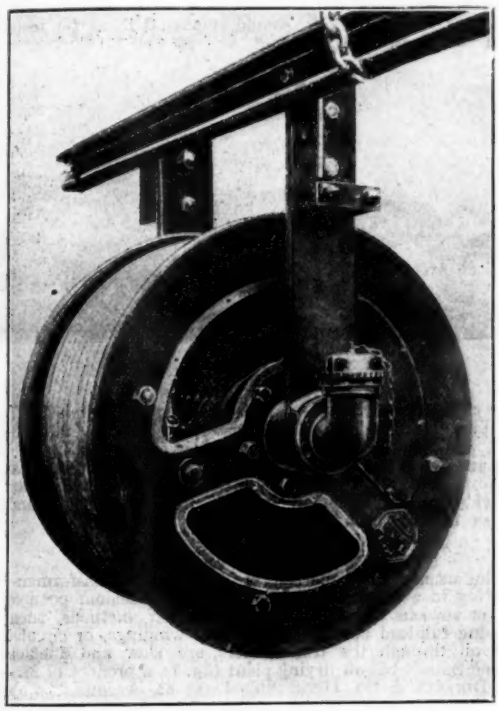


Fig. 1.—A Trailing-Cable Drum.

robust construction, and essentially consists of a main hollow steel spindle upon which is mounted the special assembly of the stationary collector rings, these being arranged so as to permit a reasonable number of rings to be accommodated, ample clearance and insulation being a necessary feature. The spindle is supported between two liberally proportioned phosphor-bronze bearings, which are lubricated by stauffers, and carry a special casting supporting the moving portion of the drum; this consists of two mild-steel end plates, rigidly braced (one side being fitted with inspection plates giving easy access to the interior), between which the main cylindrical body is fitted. This is provided with wood slats fixed at frequent intervals. Controller-type collector fingers mounted on a special insulated support transmit the current from the fixed collector rings to the trailing cable. Cable junction or plug boxes are supplied, and the drums are built for spring, counterweight, or geared control.

"Phylaxite"—a New Varnish.

PHYLAXITE PRODUCTS, LTD., 37, Walbrook, E.C., is introducing a new insulating varnish which has the advantage that it is "air-drying." Tested by a leading wireless company, "Phylaxite" is reported to be quite satisfactory up to 290 deg. F., at which temperature it perishes. It dries sufficiently in 1½ hours to be handled without damage, but sets dead hard in a few days—or in two hours if dried in an oven at 150 deg. F. Bare wires of No. 16 gauge, varnished and dried at room temperature for 16 hours, and then wound round a ½-in. spindle, showed no defect when tested at 100 volts in a mercury bath. The moisture absorption of cartridge paper, soaked in the varnish for 15 minutes, dried for 16 hours, and subjected to water vapour, was found to be less than 0.01 per cent.; absorption tests on other kinds of paper gave similar results, the amount of moisture absorbed being usually less than could be detected with a chemical balance. Tested for surface resistance on impregnated cartridge paper, the resistance per cm² was found to be 3.58×10^{4} megohms, and a layer of the same 0.028 cm. thick tested between plates 1 cm² gave a resistance of 1.12×10^{5} megohms. The puncture voltage of impregnated cartridge paper 0.028 cm. in thickness averaged 1,973 V (r.m.s.). Concentrated nitric acid attacked the varnish, and concentrated sulphuric showed a slight action, but dilute acids and caustic soda had no effect on it, and there was no free acid in the varnish. "Phylaxite" is suitable for impregnating coils, &c., which it penetrates freely.

A Lyre Fire.

The accompanying illustration, fig. 2, shows an unusual form of electric fire which is produced by Messrs. C. HARVEY AND CO., 22, Fitzroy Square, London. The design, of course, depicts a lyre, the strings being replaced by Bastian elements.

Fig. 2.—A Fire of Unusual Design.

The apparatus can be made for any loading. Two switches are incorporated in the base. We are informed by the makers that experience suggests that there is apparently no danger as a result of the open nature of the elements.

A New A.C. Motor.

In introducing their new "F" type a.c. motor, fig. 3, Messrs. HUGH J. SCOTT & CO., LTD., Volt Works, Ravenhill Avenue, Belfast, claim it to be a particularly robust machine. It is fitted with heavy ball bearings, protected by machined dust-proof cast-iron caps, with a shaft clearance of 0.005 in. The terminals are neatly arranged in the top of the stator case, and are accessible and visible to the wireman without use of a loose terminal box. The motor is strictly of the enclosed

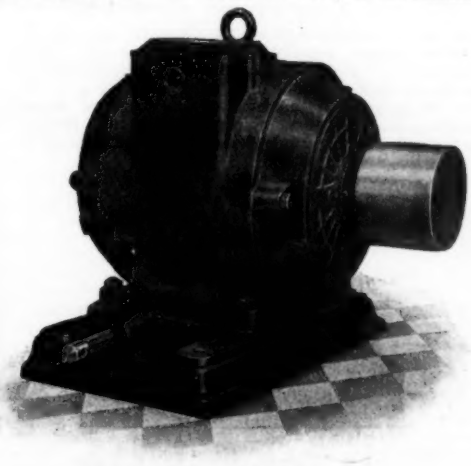


Fig. 3.—A New "Scott" Motor.

ventilated type, being designed according to B.S. specification. A special feature claimed for the motor is the absence of hum, due to the design of the slots and method of construction. The temperature rise on rated load is well within the limits laid down by the B.E.S.A.; every machine is tested under load at the works. These motors can be supplied suitable for 25, 40, 50 and 60 cycles, up to 600 volts.

An Electric Coffee Maker.

An addition to the "Jackson" products of Messrs. JACKSON BOILERS, LTD., 83, Kirkstall Road, Leeds, is a self-contained, electrically heated, coffee-making machine, fig. 4. It is self-feeding, and there is no fear of boiling the apparatus dry; the water, being treated on the "Jackson" expansion principle (ELECTRICAL REVIEW, March 12th, 1926, p. 440) is always freshly boiled, and therefore ideal for coffee-making. The

Fig. 4.—The "Jackson" Electric Coffee Maker.

coffee is stored in an earthenware lining (the level being shown on a gauge glass) and is maintained at the correct temperature by a hot-water jacket. Every part of the coffee tap can be cleaned quickly and easily, and the earthenware lining may be scalded out without trouble. It is a very simple matter to dismantle the boiling-water attachment when necessary to remove fur or other deposit. The machine is claimed to be extremely simple to operate, control being by means of a three-heat switch. High heat (2.5 kW) is used only when heating up from cold and during the actual coffee-making, low heat (0.4 kW) being ample to keep the coffee hot. The machine is therefore most economical in its consumption of electricity. The apparatus is claimed to be equally suitable for the stillroom, servery, or counter. The standard size is two gallons, but larger sizes can be made.

A Self-contained Electric Bell.

A recent introduction of the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2, is a new self-contained electric door bell. It is primarily intended for mounting on the back of a door, and is fixed in position by two screws. The brass push is mounted on the front of the door, and operates the bell by means of a brass spindle passing through to the bell. No external wiring is necessary, for all the operating mechanism and the battery are contained in the walnut-finished case, the overall dimensions being only 4 in. by 4 in. by 2¼ in. deep. The battery employed is of the ordinary 4½-V flash-lamp type, which may be clipped into position in a few seconds. The bell possesses many advantages over the mechanical type in that there are no springs to break and no mechanical winding is required. In addition, it can be adapted as a cheap and efficient portable bell set, two brass sockets being provided for the necessary external connections.

Fig. 5.—A G.E.C. Self-Contained Door Bell.

Tubular Electric Heaters.

The GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2, has recently introduced a range of low-temperature tubular electric heaters, fig. 6, designed primarily for windows and skirtings, but capable of being adapted to a wide variety of useful purposes. Being tubular, and having a large radiating surface compared with their current consumption, they can be left on circuit for long periods, thereby performing whatever duty to which they may be applied at negligible cost in current consumed. For window purposes their usefulness in preventing down draughts and at the same time keeping the windows free from steam, will be obvious; while, as skirting heaters, their unobtrusiveness, as much as their efficiency, should commend them for installation in offices, waiting-rooms, &c., as well as workshops or

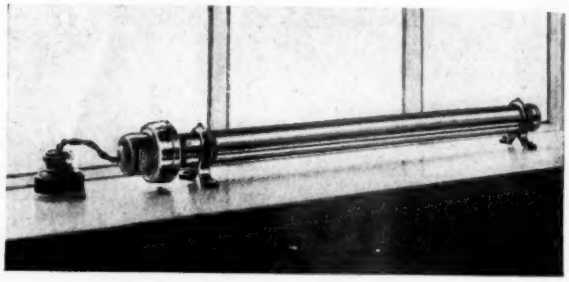


Fig. 6.—A Tubular Window or Skirting-Heater.

any places where the use of glowing coils is precluded. These heaters are standardised in three lengths, *viz.*, 2 ft., 3 ft., and 5 ft., thus serving to make convenient multiples; for instance, two can be connected on to one plug point, so as to form a heater of 4, 6, or 10 ft. in length. Each heater is provided with suitable brackets for mounting. The standard finish is black bronze.

A Drying-out Set.

The usual works method of drying out transformers by heating in a large oven under vacuum is seldom possible in power stations or sub-stations, and other methods, such as passing full-load current through the windings, or circulating hot oil through the transformers, are slow and inefficient. The "Smit" hot-air drying plant (fig. 7), a product of Messrs. G. DIKKERS & CO. (ENGLAND), LTD., 46, Avenue Chambers, Southampton Row, W.C.1, is claimed to give excellent results and have many advantages. Apart from the necessity of ensuring that all moisture is removed from every part of the transformer, it is equally important to get rid of any small metal filings or portions of cotton or fibre that may adhere to the insulation or core, and such particles are claimed to be driven off when the "Smit" drying plant is in operation, as the hot air circulates between the windings and through the gap between windings and core. In the case of medium and large sizes the transformer can be placed in its tank, after the latter itself has been first dried out, and then the hot air introduced at the oil outlet at the bottom of the tank, the outlet valve having been removed. The tank may be suitably lagged to prevent unnecessary loss of heat. For small transformers it is sufficient to dry the tank with a piece of cloth, and the transformer windings and core may be dried out in a larger auxiliary tank. The apparatus is suitable for use on d.c. or a.c. The heat is generated by resistances arranged in sections which may be used singly or together in series or parallel. In the three-phase type each phase resistance is sub-divided in this manner so that a wide range of regulation can be obtained. The volume of air can be regulated by varying the speed of the motor-driven fan. A thermometer and temperature relay are fitted, the relay to give warning if the temperature of the resistance becomes too high. The apparatus is made in two sizes with capacities of 400 and 800 cu. ft. per min.

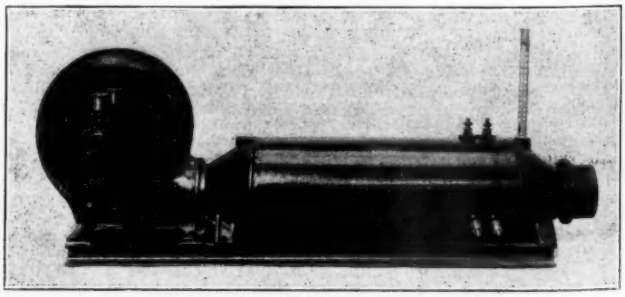


Fig. 7.—The "Smit" Hot-Air Drying Plant.

Electric Ploughing.

The author's experimental work in England, and some account of operating experience in other European countries.

By R. BORLASE MATTHEWS, M.I.E.E., &c.

(*Extracts from paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

FARMING, in the course of history, has passed through a succession of severe crises, the remedy for each having been the evolution of new ways of farming. To solve the present farming crisis, agriculture will undoubtedly have to be industrialised with the aid of electric power, hence the subject of this paper, which covers the author's own experimental work and the result of experience of observing electric ploughs in operation in other countries, over 200 of these machines being now in use abroad; an electric plough can be usefully operated for 200 days in the year.

The objects of ploughing, the efficiency of the implements, the power required, the differing classes of soil, methods of electrical distribution, and tapping the necessary supply are described; they are simple in principle and reasonable in cost. The principal practical types of plough are described; they include the large double-winder steel-rope machines, based upon 40 years' experience of British steam-plough practice (only suitable for large areas and co-operative or contractor owning, as they cover 12 to 30 acres per day); also there is the newer development of the small class of plough, suitable for the individual small farmer or market gardener constructed on the revived round-about system and also on the tractor system. The author's idea of the best form of this smaller type of plough is given, rotary tillers are briefly described, the cost of electric ploughing is discussed, and the large-scale development of electric plough contracting under the auspices of electricity supply undertakings is mentioned.

In Great Britain there is only one plough in an operating condition, and that is on the author's farm. The first British-built electric plough, made by E. O. Walker & Co. for Mr. Chorlton, of Cotgrave, is now employed on timber haulage. Major A. McDowall's first plough has been dismantled, though designs are nearly ready for an improved model. Based upon the design of the author's plough, Mr. J. O. A. Fraser MacKenzie recently constructed an electric plough in this country, but it has been sent to his farm in Rhodesia. The leading British makers of steam and oil-engine ploughs have designs ready for electric ploughs. Electric ploughs are in use in vineyards in the South of France, which are a far worse proposition than the smallest of fields. If electric ploughing is adopted seriously it will bring about the necessity for a drastic revision of rural distribution networks.

It is at times difficult to differentiate between the operations usually called ploughing and cultivation, and the various implements employed therefor, though for economic reasons the same electrical equipment would probably be used for many of the required purposes, as well as for a number of harvesting tasks.

The efficiency of the present-day plough is very low. Experiments at Rothamsted showed that in one field the soil resistance varied over a range of 40 per cent., while the type of plough used and different methods of adjustment also cause the resistance to vary; different methods of hitching have shown an increase of 34 per cent. in draught, and a re-pointed and re-sharpened share needs 7 per cent. less draught than a dull one, while a new one reduced the draught by 36 per cent. over the re-sharpened one. Where tractor mechanical ploughing is done, a rolling coulter reduces the soil resistance and cuts a clean furrow which can be easily turned by the mouldboard.* The use of a subsoiler causes a large increase in draught, as the hard pan produced by previous ploughing is broken up; the draught is proportional to the width of the furrow; an increase of speed of from 1 to 2½ m.p.h., or 150 per cent., increases the draught by 14.5 per cent. Some modification of the design of the plough will, however, be needed before any appreciable change can be made in the matter of speed. By chalking the land, in heavy clay the draught can be reduced by 15 per cent. A more recent method is due to work at Rothamsted, and afterwards full-scale experiments on the author's farm at East Grinstead, on an electrical method of reducing the friction at the mouldboard of the plough. Soil colloids are electro-negative: by keeping the coulter positively charged and the ploughshare negatively charged, the latter becomes coated with a film of water, which is an almost perfect lubricant, the resistance of the soil being thereby considerably lowered.

The cost of electric ploughing depends so much upon special circumstances in each area that it is impossible to give any exact figures. However, Table I has been calculated on the figures given by manufacturers for the output of some of the machines described in the paper. The working period has been taken at 200 days; depreciation is spread over 15 years, and an allowance has been made for the replacement of the electric cable every two years. To these figures must be added overhead expenses, &c., but even when 150 per cent. is allowed for all other charges, the cost will be found to compare favourably with the charges made for all other forms of ploughing.

* The mouldboard is the breast of the plough, which is attached immediately behind the share, and is so formed that it turns over the furrow slice raised by the latter.

TABLE I.—*Cost per Acre of Electric Ploughing; ordinary Soil from 6 to 8 in. deep.*

	Double-rope system with two haulages.	Modified double-rope system with one haulage and anchor wagon.	Anchor pulley system without pulley wagons.	Tractor.
	s. d.	s. d.	s. d.	s. d.
Depreciation ...	0 8½	0 8	0 6	0 6
Interest, 6% ...	0 8	0 7	0 5	0 5
Cable	0 8	0 6	0 3	0 5
Repairs	0 8	0 7	0 3	0 5
Labour	1 8	1 5	3 0	1 4
Electricity at 1d per kWh ...	1 3	1 6	1 8	2 0
	5 7½	5 3	6 1	5 1

Discussion.

MR. LL. B. ATKINSON opened the debate by pointing out that ploughing absorbed most of the electric power that was used on farms, and it was therefore the pivot on which rural electrification would turn. The present crisis was due to all costs being now 70 per cent. greater than the 1914 figures, whereas the increased price the farmer obtained for the produce he sold was very small; that fact had brought arable farming to the verge of bankruptcy. In the South of England 75 per cent. of the tenant farmers had tendered notices last September to terminate their tenancies at Michaelmas, which meant that the land would become derelict. Probably the best remedy was being tried in Oxfordshire and Wilts., where small villages, buildings, &c., were being pulled down to allow of the creation of great open fields of the prairie type, so that ploughing and similar operations could be carried out on a large scale with the aid of machinery; that meant some depopulation, but also more efficient farming. The heavy clay soil in many parts of England was not light enough to be suitable for rotary tilling; deep cultivation was also not possible in many parts because the layer of soil above the chalk was not thick enough to prevent the latter being turned up. The facility with which electric power could be measured was valuable, and the ammeter would teach them how to plough properly. In his list of the advantages of electric ploughing, the author had included the "increase in acreage available for producing marketable crops. Prof. Fletcher, of the University of California, has calculated that, on an average, 24 per cent. of the wheat, 67 per cent. of the oats, and 44 per cent. of the hay produced on a farm are used for feeding the working animals. If electric power is used, all this produce is available for sale." Those proportions seemed to be hopeless to the engineer; if he could prevent that waste and enable that much extra food to be marketed, he would have achieved something worth while.

Mr. W. FENNELL explained that tenant farmers had not got the money wherewith to purchase plant, and therefore some hiring scheme was needed. It was essential that the regulations for the erection of both high- and low-voltage country power lines should be relaxed; easement of the l.p.-line regulations alone would not suffice. Little rural work was being done in this country, for it was at present necessary to obtain guarantees from rich people before much could be done. Making supplies available to country houses and villages was not real rural electrification. It should be remembered that much of the land in England would have to be properly drained before it would be in a fit condition to permit of heavy machinery being worked on it.

Mr. B. M. JENKIN did not agree that it would be possible to operate tractors and ploughs on 200 days per year in this country, neither did he agree that the simple displacement of horses by tractors was the right way of employing power. The plough was still in its original primitive form; though the rotary tiller was a step in the right direction, it did not do quite what was required. Instead of trying to perfect tractors and haulage systems, would it not be more satisfactory to attempt to design a digger which would do a variety of work, turn over the soil, and bury weeds in a similar manner to the ordinary gardener's spade?

Prof. C. L. FORTESCUE associated himself with Mr. Atkinson's remarks, and thought the last speaker had put his finger on the right spot. He referred to the manner in which the

land was divided up into a multitude of small irregular farms, arable and stock farms being mixed up, with four or more separate owners and tenants in quite small areas; therefore, contract ploughing and similar operations could not be contemplated in this country for some time, until the countryside had been rearranged.

Mr. H. HODGSON (Messrs. Fowler & Co.) compared the cost of ploughing by various means, and was understood to say that equal costs would obtain with coal at 25s. per ton, Diesel-engine oil at 4½d., petrol at 3½d., and electricity at 1d. per kWh.

Major A. MCDOWALL congratulated the author on having found it possible to reduce the cost of power from 2½d. per kWh mentioned in his last paper to 1d. in the present one; at that figure things would pay well. The Canadian was able to beat the home farmer, not because he had better land or raised better crops, but because he had cheap power on his farm in the form of horses and fuel. Education also played its part, the average farm hand being much better educated to-day than he used to be; accordingly, if he were given a better tool to work with he would take interest in it and do more and better work with it.

Major T. RICH said that few highly-skilled men were required for electro-farming; he would rather term them intelligent labourers. In France high-voltage power lines had been standardised because they cost little more to erect than lower-pressure lines, and that country had been electrified without the erection of super-power stations or "grids" of transmission lines. Rumania, which formerly exported much grain, had been divided into small holdings, with the result that she now produced insufficient grain to feed her own population. England had no monopoly of bad weather, and in France to take advantage of a spell of fair weather field work was continued throughout the night with the aid of acetylene flares. Country power lines must be erected at a cost which rural areas could afford.

Mr. J. T. IRWIN thought that an alternative to Mr. Atkinson's remedy was to retain farms at their present size, but to work them better; that was, to raise better and more crops from the same area. The present type of cultivator was wrong; a machine was needed that would combine several operations and leave the ground, after one operation, ready for the seed.

Mr. E. KILBURN SCOTT drew attention to a new type of plough which had been made (Storey patent) by Messrs. J. Fowler & Co. (Leeds), Ltd., on the principle of rotating two sets of ploughs outwards from the centre on a horizontal plane.

Mr. R. B. MATTHEWS, in reply, said that electric ploughs were commercial products and could be purchased in England as such now. He desired all field work to be carried out electrically, which could be done, but present types of machines would have to be modified.

[The paper was illustrated with numerous lantern slides and a lengthy kinematograph film.]

The Overhead Lines Association.

Proposed Revision of Overhead-line Regulations.

AT an ordinary meeting of the above-named Association at the Institution of Electrical Engineers, London, on November 30th, Mr. R. Borlase Matthews presiding, it was announced that the Association had divided the country into areas (similar to those adopted by the Institution of Electrical Engineers) and the following Sectional Chairmen were unanimously elected:—Scotland: Mr. W. C. Bexon; Northern Ireland: Mr. F. H. Whysall; North-East England: Mr. P. F. Allan; North-West England: Mr. W. Fennell; Yorkshire: Mr. J. E. Storr; South Midlands: Mr. J. T. H. Legge; Mersey and North Wales: Mr. C. D. Taite; Western Section: Mr. C. T. Allan; Northern half of South-East Section: Mr. B. G. Drummond; Southern half South-East Section: Mr. W. A. Turnbull; London: Mr. A. T. Scott, and Mr. R. Borlase Matthews was unanimously elected president of the Association.

Articles of Association have been drafted on the basis of those of the Institution of Electrical Engineers and the Diesel Engine Users' Association, it being explained by the chairman that the latter had been taken partly as a model owing to their simplicity.

Introduction.

Col. R. E. CROMPTON, who, at the request of the president, addressed the meeting on the general question of rural supplies, said that Mr. Borlase Matthews and himself were on a sub-committee which had been appointed by the Electricity Commissioners to deal with this subject, and he protested against the statement made by the Prime Minister, and others, that the cost of generation was the important factor in the supply of electricity; the cost of distribution was the all-important factor, and every effort must be made to keep down the cost of distribution if rural electrification was to take place. In that respect he emphasised the necessity for modifying the powers now possessed by the Postmaster-General, inasmuch as the obligations he could place upon electricity supply authorities made rural development impossible. The Postmaster-General must be compelled to keep to one side of the highway, for instance, and electricity supply authorities should be allowed the other, and also to string high-voltage and low-voltage cables on the same poles, which would mean a modification of the existing overhead-line regulations. The first essential, however, was to press for legislation in order to ameliorate the position so far as the rights of the Postmaster-General were concerned. He believed that they would have to visualise poles 30 ft. high for rural electrification, and possibly 35 ft. high, with high- and low-voltage mains on the same posts; he had been getting out estimates for rural work which suggested that for an addition of 30s. per annum on the rent of cottages, plus about 2½d. per kWh, such work could just be made profitable to start with, provided the overhead-line work could be done at a reasonable figure. Some estimates he had been getting out showed that the capital cost must not be more than about £1,500 per village. As the demand grew, the charge per kWh would be capable of reduction to 1d. As a matter of fact, in the West End of London a reduction was to be made immediately to a charge of 4d. per kWh for lighting and 1d. per kWh for power. As a means of solving the problem of electricity supply in villages, he advocated the use of local storage batteries.

Overhead-Line Regulations.

Mr. W. FENNELL then read a paper on "Overhead Regulations," in which he briefly traced the history of electricity supply in this country and the manner in which the existing overhead-line regulations came to be drafted by the Board of Trade. The Electricity Commissioners, said Mr. Fennell, were now seeking advice for re-framing the regulations, and the object of his paper was to make concrete suggestions which could go forward from the Association as representing the views of those who were directly connected with the erection and maintenance of overhead lines. The whole object of the use of overhead lines was to cheapen the cost of giving the supply to the consumer, but so hedged round was the erection of overhead lines with regulations at the present time that Mr. R. K. Robertson, of Dundee, with a show of reason, had claimed that he could provide and lay cables as cheaply as he could erect overhead lines.

Dealing with the subject in some detail, Mr. Fennell said there was no need to-day to distinguish between high- and low-pressure regulations, for 250 volts would kill and 25,000 volts could do no more; therefore, he suggested that in the revised regulations all pressures should be treated as being dangerous if touched. Thus, extra safety would be provided at the lower pressures. At the same time, there was no great cause for complaint against the existing regulations, if they were applied to 33,000 volts and over. It was also suggested that it was not necessary, or desirable, to have lines much higher than was required to pass traffic, and the following clearances were put forward as a reasonable basis for discussion:—

(1) Across or within, say, 8 ft. of any public road, 20 ft.

(2) Across or within, say, 8 ft. of any private road liable to wheeled traffic, 18 ft.

(3) Across any farm road, arable land, or mowing grass, 17 ft.; or the height of a loaded hay wagon, plus 5 ft.

(4) Across commons or moorland and along hedges, the height of a man on a horse, say, 10 ft., plus 5 ft.; or 15 ft. in all.

(5) Across water (not navigable), or waterlogged land incapable of supporting wheeled or horse traffic, 10 ft. was ample.

It was also desirable to rely upon methods which kept the lines on the poles and so avoid all dangerous earthing guards to catch lines as they fell. Multiple earthing of the neutral wire provided a safe earth for pole ironwork and avoided the present serious danger of earthing at the point of origin only. Again, the limit of pressure variation should be increased, the limits suggested being 8 per cent. up and down; and it was contended that the suggested modifications would provide safe and sightly poles and lines, instead of the gaunt, guard-garnished, gallows which caused so much criticism to-day.

Mr. Fennell maintained that the reform he had suggested in the reduction of height of poles would reduce the cost of poles by 30 per cent. in rural districts. He also asked that other materials than copper and aluminium should officially be allowed for cables (those were the only two materials mentioned in the present regulations) and that there should be a factor of safety for line wires of 2, at 22 deg. F. with ¼-inch radial thickness of ice and a wind pressure of 8 lb. per sq. ft. Alongside highways and across, or over, public footpaths and public bridle roads, also across or over private roads, or within 8 ft. of them, double suspension was suggested, whilst across or over public highways, or carriageways, double suspension with stranded wires was recommended. Over Post Office lines

double-suspension double wires were recommended, whilst under P.O. lines it was suggested that two earthed steel, or h.d. copper, wires should be provided above the power line at a height of 2 ft. above the highest conductor and 2 ft. wider than the conductor spacing.

The paper dealt with many other details, but the above extracts indicate the general outlines of Mr. Fennell's proposals, which were discussed at considerable length; indeed, the meeting lasted for three hours.

Discussion.

The CHAIRMAN said a letter would be sent round to all who had knowledge of, or were experienced in, overhead-line construction asking for their opinions on these matters and the suggestions would be sent forward to the Electricity Commissioners. The object was to learn the feeling of experienced overhead-line engineers in the country, and the Electricity Commissioners would be placed in possession of those views.

Mr. GRIFFIN, speaking with experience in India, welcomed the proposed modifications of the regulations because the regulations were usually adopted as a model for the Dominions and Colonies. Personally, he objected to a height of 20 ft. over roadways and within 8 ft. of them, and a resolution had been passed by supply engineers in India unanimously recommending 17 ft. along roads and 20 ft. across.

Mr. W. C. BEXON suggested that 18 ft. was a sufficient height for certain public roads and 17 ft. was certainly ample alongside roads. On farm roads 12 ft. would be sufficient in many cases, where there was practically no traffic. It was essential to reduce the existing heights if the cost of construction was to be reduced. He also considered the regulations as to ice loading excessive. In his area he had a number of outdoor transformers and sub-stations and one sub-station had a capacity of 12,000 kW, but he had never seen any snow or ice on the wires.

Major T. RICH spoke of the practice in Continental countries of putting high- and low-voltage lines on the same poles. Double conductors were used for a time on the Continent for road crossings, but they were gradually going out as the ordinary construction was found to be strong enough. A limited span with a larger factor of safety and insulators were used for telephone and telegraph lines and road crossings. It was also absurd that a concrete pole should have to have a higher factor of safety than an iron or steel pole. It was often said that the regulations in this country were analogous to those in many Continental countries, but if one read the letters and memoranda issued in conjunction with the regulations in most Continental countries it would be seen how the actual regulations were relaxed in favour of the supply authorities.

Mr. W. A. TURNBULL (Aylesbury) said that although if one wanted to do anything differing from the regulations special application could be made to the Commissioners, there was great delay. He had known such applications to take three months before a decision was given. He, too, differed from Mr. Fennell as regarded a height of 20 ft. across or within 8 ft. of a public road and believed 17 ft. ample. Similarly in less important roads a height of 15 ft. was ample. There might also be variation of the limit of voltage variation during the day and night time, say, 5 per cent. during certain day hours and 10 per cent. during the remainder.

Mr. COATES (New Zealand) spoke of the manner in which all interests in New Zealand met together and drew up the overhead-line regulations there.

The CHAIRMAN, remarking upon the fact that the Commissioners had held a conference to discuss the question, said that they had merely called upon certain engineers who they thought would be able to give useful advice. They had not called on representative Associations to nominate representatives, however, and it was with the view of helping the Commissioners to the fullest extent and enabling them to get the views of the people really concerned that the letter he had referred to was to be sent out.

A number of other speakers took part in the discussion and expressed views more or less in line with those set out in the paper, although varying as regards heights, factor of safety, ice loading, &c., and a show of hands was taken on a number of these matters to guide the Council of the Association. In the main, the result of this rough voting was in favour of slightly lower limits than those set out in the paper, but more exact figures will be obtained later, although it was pointed out that the information would not bind any member, it being required merely to give the Commissioners an indication of what the general views were. Incidentally, the view was expressed that, but for the activity of the Association, the Commissioners might not have taken the step they had of calling in engineers to discuss this matter.

Mr. W. FENNELL had also prepared a note on the subject of wayleaves, which will be considered by the Council of the Association.

At the next meeting of the Association, on January 11th, French regulations will be discussed.

Cheap Electricity.

Improved load factor the keystone of cheaper electricity: the economy and some of the advantages of employing heat-extraction plant.

By A. B. MALLINSON, M.I.Mech.E, M.I.E.E.

(*Abstract of Chairman's Inaugural Address before the* NORTH-WESTERN CENTRE *of the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE manufacturing area around Manchester is one of the best served districts in this country so far as cheap electricity is concerned. The energy generated and total working costs of six of the leading public supply stations in the North-Western area for the year ending March, 1926 (so as to keep clear of the fluctuations caused by the coal miners' strike) are as follows:—

Undertaking.	Energy generated, kWh.	Working cost, d. per kWh.
1. Bolton	50,066,009 ...	0.61
2. Manchester	300,440,765 ...	0.64
3. Salford	49,776,217 ...	0.68
4. Stockport	32,301,059 ...	0.63
5. Stalybridge	31,991,781 ...	0.48
6. Oldham	45,564,621 ...	0.61
Total	510,140,452	Average 0.627

The position of these stations as regards working costs may be gathered from the fact that out of 217 stations in the list of local authorities, only 21 operated in 1926 at below 0.7d. per kWh, and eight of them were in the North-Western area.

One of the biggest drags on the electricity supply industry is the multitude of rates and methods of charging for electricity, but improvement of load factor is the keystone of cheaper electricity; we shall find it in this area by: (*a*) the education of the public to use electricity in the home, (*b*) the electrification of our suburban railways, (*c*) the supply of the rural residential areas and farmers, (*d*) further development of industrial power. Literally hundreds of mills in this area are rope-driven by Corliss or drop-valve condensing steam engines; they are generally laid out on sound mechanical lines, and the capital costs of such private power plant are largely, or fully, written off; hence their cost of power is little more than the equivalent of the electricity supply station working cost, and power near to 0.5d. per kWh is the magnet needed to draw them.

Cheap heat is the vital link without which many works cannot operate: steam generation electrically is a proved commercial practice, but modern industrial steam-raising plant (Lancashire boilers) in heat-extraction works in this area is producing their steam at 1s. 3d. per 1,000 lb. and upwards, so that to raise steam at the same cost electricity must be available at 0.056d. per kWh.

There may be interesting developments in the next few years, if a supply were offered at, say, 0.15d. for a night load with the use of a heat accumulator. For works making a very small and variable demand for process steam electric steam raising at even 0.25d might merit serious consideration. So long as our super stations have a thermal efficiency of from 20 to 25 per cent., it obviously will be out of the question to eliminate the self-contained heat-extraction plant with its 50 or 60 per cent. thermal efficiency from all those industries wherein the power and heat demands synchronise sufficiently; plant as small as 100-200 kW does generate for a total working cost of 0.15-0.25d. per hour, and capital charges add about 0.15-0.2d. in the case of 48-hour week operated plant, but only 0.06-0.075d. in the case of paper mills and other industries operating on a 132-hour week. The total cost which public electricity supply must compete against is, therefore, 0.3-0.45d. in the case of 48-hour week operation, down to 0.21-0.325d. for night and day operation.

Does heat-extraction plant really in practice make the savings claimed? Let me quote you a few of many local examples:—Two esparto paper mills, considered to be among the most up-to-date in the country, have, since installing heat-extraction power plant, reduced their coal consumption

by 24.25 and 31.75 per cent., respectively, which means in round figures 5,350 and 7,350 tons of coal per year.

In a dye works the installation of a heat-extraction plant costing £4,000 reduced the coal consumption by 364 tons, and entirely cut out bought electricity costing £1,600 per year.

A mental hospital has had heat-extraction in operation for 13 years without a single shut-down; during the 10 years prior to the coalminers' strike, using the same grade coal, the consumption year by year has been kept practically constant, but the units generated have increased 120 per cent.

A hospital which had a heat-extraction plant consumed some 2,000 tons of coal per year; presumably because it was considered wasteful, the plant has been replaced by a supply of electricity from the public mains; the result is practically the same coal bill, plus a bill for electricity of some £2,500 per year.

Such examples as the last one do the electrical industry no good, and I venture to suggest that they will disappear if power supply engineers will take a broad national view on these lines: Encourage the manufacturer to install heat-extraction plant and offer him a reasonable amount of electricity, on the basis of a suitable guarantee sum per year, which the manufacturer can expend on taking a supply at night, or as stand-by. If the conditions are such that there is always an appreciable surplus of power over heating demand, arrange to buy surplus energy from him. Many small engine-drive sets of 100-500 kW in the stations that are being closed down could be easily adapted for heat-extraction operation, and by so doing the supply engineer stands to benefit in several ways:—He will have a satisfied consumer (one with a continual grouse will do more harm than a dozen active canvassers can mend); he will mainly get load when he wants it (*i.e.*, at night); he will get a supply of (surplus) energy quite as cheap as he can generate it himself; and he will be "on the job" for any extension the user may require beyond what his own plant can deal with. Our coal reserves are not limitless; why therefore should we go on wasting millions of tons of coal per year by driving factories which require process steam with bought kelvins?

The Institution of Electrical Engineers.

Annual Dinner of Mersey and North Wales (Liverpool) Centre.

FOR the first time in its history the toast of the Institution was proposed by a lady, the Lord Mayor of Liverpool, Miss Margaret Beavan, J.P., at the annual dinner of the Mersey and North Wales (Liverpool) Centre of the Institution at Liverpool on November 30th. Mr. Archibald Page, president, commented on the uniqueness of the experience and, incidentally, referred to the lady members of the Institution who, he said, would be much encouraged by the interest of the Lord Mayor of Liverpool in their industry.

The Lord Mayor of Liverpool, Councillor Margaret Beavan, J.P., in proposing the toast of "The Institution," referred to the passing of the city electrical engineer (Mr. Harold Dickinson), a faithful citizen who would be greatly missed. He was a man of vision and strenuous endeavour, and had performed a great work for the city. One of the greatest services that could be rendered the nation would be the cheapening of power so that the working-class mother might be relieved of the grind of mechanical and irksome duties. There were 254 all-electric houses in Liverpool. What were 254?—but they were a beginning and augured the drawn of the electrical era. Electricity helped to lubricate life.

Mr. Archibald Page, president, said his lot in life incorporated two positions of responsibility and, intellectually, he had to divide himself in two. Fortunately such an awkward position had its compensations; for instance, on the one hand, there was Mr. Page, acting chief engineer, finding himself thwarted, could overcome the position by switching on the auguster "Me," the President; on the other hand, when the president made a statement and gave reason to doubt whether he was so pontifically infallible, he could always conveniently throw the blame on the scapegoat chief engineer. Each of these persons was impressed with the multifarious duties of the other; this was the age of specialisation and he had to confess that the "presidential me" was the more difficult job. That district would, in due time, be given a scheme; he hoped when it was produced it would be sufficiently sugar-coated to suit the palates of the people in the North. That area was the fourth on the list and would be included in the scheme for Lancashire and Yorkshire. There had been great unexampled progress in electrical engineering recently, and all expansions meant change of method; all progress was based on trial experiments, and it was there that the interchange of knowledge became so important. It was only through an institution such as theirs, that the interchange could best take place. If the creation of the Central Electricity Board had done no more, it had at least given a new orientation to the whole industry: the outlook was changed, not only from the legal and Parliamentary points of view, but also from the standpoint of engineering. Engineers would have to think along new lines and face fresh problems and new difficulties: those concerned with generation would have to remember that henceforth they would be part of a bigger and national scheme; those concerned with distribution might congratulate themselves that they would have more time and opportunity to develop new ways of applying electricity.

Mr. S. B. Freeman, president, Liverpool Engineering Society, proposed "The Electrical Industry," and commented on the big movements that were taking place in this branch of industry. After making reference to electrical progress on the Continent, by the creation of a network of supply lines, he said it was high time that similar steps were taken in this country. He did not see how it could be accomplished with the same economic results, unless in this country there was the same freedom as on the Continent. Tremendous advances had been made in the application of electricity in the mercantile marine service. Every ship had its staff of certificated engineers, but not certificated electrical engineers. He suggested that the Board of Trade should institute examinations and certificates for seagoing electrical engineers, in the same way that it did for mechanical engineers.

Mr. J. S. Highfield, past president of the I.E.E., responded. He remarked that they had been in the political frying pan for a long time, and had been bothered with regulations, laws, and changes. They were now out of the frying pan and in the hands of the Central Board. Would it be the fire that would consume? was the question all wanted answered. Personally, he believed they would have the chance of going forward in a way that had not been possible for a long time. He hoped that they would not have any more legislation. Behind the electricity supply industry there were great manufacturing concerns whose prosperity they wanted to see. The manufacturers made one mistake by creating a good design; instead of making money out of it, resting on their oars for a little while, they immediately brought out a better one. The fact could not be overlooked that the manufacturers were the backbone of the electrical industry.

"Our Guests" was proposed by Mr. H. H. Harrison, M.I.E.E., and responded to by Alderman F. C. Wilson, J.P., chairman of the Liverpool Tramways and Electric Power and Lighting Committee. That authority, he said, last year registered a maximum demand of over 78,000 kW and, judging by the increase of load which had already taken place, it was probable that the maximum demand this year would be over 90,000 kW. On several days this year 1,000,000 kWh had been generated during the 24 hours. Much of the development and progress in electrical machinery, both for generation and distribution, was due to the initiative of the large manufacturers; but their efforts would have been of little avail unless backed by large users prepared to install plant of new design. This, at times, might mean the acceptance of some degree of risk, but if such risks were not taken by the users, how could progress be made? During the coal miners' strike of last year, 36,786,000 kWh was generated with oil fuel. The No. 3 station now contained two 25,000-kW turbo-alternators, the first of which had generated to date 122,000,000 kWh and the second would be on load before the peak of the coming month, but the load had grown at such a rapid rate that further plant must be installed to be available for the winter of 1928-29. Preliminary plans were already in course of preparation for further extensions.

Prof. C. H. Reilly, O.B.E., M.A., president, Liverpool Architectural Society, made particular reference to the smoke evil and to overhead transmission plant. "If we have to have structures to carry electrical wires," said Prof. Reilly, "let us have them as simple as possible." Architects had a great deal for which to thank electricians, especially the interior lighting of public buildings.

Mr. P. J. Robinson, M.I.E.E., in proposing "The Chairman," referred to the loss which the staff of the Liverpool Corporation Electricity Department had sustained by the death of its chief, and feelingly acknowledged the expressions of regret that had been received from members of the electrical industry.

Prof. F. J. Teago, D.Sc., M.I.E.E., responded.

An Electric Lighthouse.

The old system of illumination by incandescent gas burners in the lighthouses at Burnham-on-Sea, Somerset, has been superseded by automatic electric lighting, the first installation of its kind by Trinity House in this country. The new system was successfully introduced on November 23rd.

Parliamentary News.

[By Our Special Parliamentary Reporter.]

The Holborn Automatic Exchange.

On November 29th, Mr. DAY asked the Postmaster-General whether the new Holborn automatic telephone exchange was now working satisfactorily; and whether the telephone authorities had received any complaints with regard to the change over of this exchange to the automatic system.

Sir W. MITCHELL-THOMSON said that the new Holborn automatic exchange was working satisfactorily. It was inevitable that some difficulties should be encountered in connection with a change of system involving so complete an alteration in mechanism and in methods of operation, both on the part of the staff and of subscribers. The complaints received related mainly to initial difficulties occurring during the transition period, and could not be separated as between those due to defects in the apparatus or in the operating and those attributable to inexperience on the part of subscribers.

Parliamentary Lighting.

On November 30th, Sir H. BRITTAIN asked what electricity staff was on duty in the Houses of Parliament each day after 6 p.m.; and what precautions were taken against the failure of the lighting system.

Sir V. HENDERSON said that the electrical staff on duty at the Houses of Parliament from 6 p.m. until the House rose consisted of a foreman and two electricians. As regarded the second part of the question, apart from arrangements which had been made for alternative sources of supply, everything possible was done to ensure that the installation within the building itself was in perfect order. The electric wiring throughout the building was also being gradually renewed and the likelihood of a failure was practically negligible.

Oil from Coal.

On December 1st Mr. HARDIE asked what progress had been made since May last by the Bergius process for the extraction of oil from coal.

Lord E. PERCY said that work on the Bergius process had continued steadily at the Fuel Research Station and the results had confirmed that large quantities of liquid fuel could be obtained from coal by this process. A beginning had been made in the investigation of the whole question of the action of hydrogen on coal under different conditions, and interesting results were being gradually accumulated. There could be no doubt about the interest and importance of the process referred to, but it was no part of the duties of the Department to offer opinions on the purely commercial aspects of the inventions which it made or investigated.

Legal.

Loud-Speaker Directors' Dispute.

MR. JUSTICE ROMER, in the Chancery Division on December 2nd, had mentioned to him cross-motions between directors of Artandia, Ltd., makers of ornamental loud speakers. There was one motion by Marquis di Andia Yrarrazaval and Col. J. C. Brinton against Lord Redesdale, Commander Tatton Bowles and Capt. R. Willans, and the other was by Lord Redesdale and Commander Bowles against the Marquis.

It was agreed, however, that owing to the conflicting and complicated nature of the evidence, steps should be taken to maintain the *status quo* of the board until the trial of the action, and that meetings should be held in the meantime to ascertain the views of the shareholders.

Claim Under Trade Unions Act, 1927.

AT Birkenhead County Court, on November 28th, Mr. Arthur E. Stafford, Birkenhead, sued the Birkenhead Corporation for loss of wages owing to wrongful dismissal. He also sought a declaration from the defendants that they had acted unlawfully, and an injunction restraining them from so acting in future. Council for the plaintiff said that the proceedings were taken under the Trade Unions and Trade Disputes Act, 1927, which provided that no public authority should require as a condition of employment that an employé should be a member of a trade union. In August last the plaintiff was engaged by the Corporation Electricity Department and shortly afterwards was approached by two trade unions—the Electrical Trades Union and the National Union of Enginemen, Firemen, Mechanics and Electrical Workers—to become a member. He joined the latter union, but he was again seen by the local secretary of the E.T.U., who later threatened to call a strike if the plaintiff was not stopped. The plaintiff was then dismissed, the borough electrical engineer explaining that the Electricity Committee had decided to employ only members of the E.T.U. At the expense of some trouble Stafford managed to get himself transferred to the E.T.U. and in September he was re-instated.

The JUDGE said that there had undoubtedly been a violation of the statute and plaintiff would be awarded £16 19s., representing four and a half weeks' wages, together with costs. He did not propose to grant an injunction against the Corporation, but he thought that plaintiff was entitled to a declaration. There would be liberty to apply for an injunction, although he (the Judge) hoped that that would not be necessary.

Alleged Fraudulent Prospectuses.

AT the Mansion House on November 30th Sir Charles Buckworth-Herne-Soame, Bt., Robert G. Harley, and Col. Edmund O. Eaton, again appeared before Ald. Sir George Truscott upon charges of conspiring together and with others to defraud such persons as might receive prospectuses issued by the Chalk Fuel Power Gas and By-Products Corporation, Ltd., and to obtain money from them by representing that the reports which appeared in the prospectuses were true and made by those purporting to have made them. At the previous hearing evidence was given by Mr. G. H. Franklin, an engineer, who said that he had tested the fuel but that the reports which appeared were not his or anything like his reports. Evidence was also given by a clergyman, who said that he had been induced by the statements in the prospectus to subscribe for shares in the company.

Upon the resumption of the case, Mr. Franklin was cross-examined by Mr J. P. Valetta, defending Counsel. Witness again stated that he had found the fuel unsatisfactory, but he had no copies of his report. He had not seen a newspaper report stating that the test had proved satisfactory until it was shown to him by the police. He certainly did not inspire the report or authorise anyone to write it. The statements made were untrue.

The hearing was further adjourned until December 8th.

Workmen's Compensation Award.

JANE NORRIS, a widow, Stafford, was awarded £300 compensation, with statutory amounts for her two children, at Stafford County Court, on December 2nd, against the English Electric Co., Ltd. It was stated that the applicant's husband was employed as a painter at the respondents' works, and while painting a girder from a crane he fell from a height of 25 ft. and was killed instantly.

Correspondence.

Correspondents should forward their communications as early as possible. ***No letter can be published unless we have the writer's name and address in our possession.***

The Testing of 33,000-Volt Cables.

The article by Messrs. Höchstadter and Bowden on this subject is a meritorious effort to bring about some standardisation in the testing of super-tension cables.

At the present moment specifications are so varied and in many cases so elaborate in their attempts to attain the required security that it is time some co-ordination was obtained and the matter put upon a more generally accepted basis.

With the introduction of "H" cable into this country there has been a great deal of controversy with regard to the correct method of testing it, and no doubt much of the misunderstanding is due to confusion with the normal three-core "belt" type of cable. It has been customary to test the latter at about 2½ times working pressure with 3-phase voltage, usually for 15 minutes, with a test of 3 cores to sheath depending upon the belt thickness. With increasing voltage the latter has had a tendency to increase—chiefly for mechanical reasons—and thus the majority of belt-type cables for the higher voltages have been fully insulated to earth. The "H" type, not having the defects both mechanical and electrical of the other type, needs no greater insulation thickness than that required for the working pressure to earth. Since the two types, however, are to some extent in competition as alternative designs for pressures up to 33,000 V, the "H" cable has been expected to withstand the same tests in all cases. Thus one frequently comes across tests specified for "H" cable that correspond to those for a fully insulated belt cable, such as a figure of 50 kV to earth on a normal 22,000-volt cable. Usually in these circumstances any attempt at modification is rather looked upon as a declaration of weakness—whereas, of course, the whole thing is purely a misconception of the fact that the two cables are of entirely different design, and should be treated accordingly.

I am glad to see that the authors have emphasised the single-phase testing with regard to "H" cables—the question of 3-phase routine testing of such cables is still considered as essential in some quarters.

The stability test put forward in the article calls for precision measurement, the most important factor in which will certainly be the question of temperature, as is especially noted. The final power factor, which according to the suggested specification must not exceed 0.015, will depend upon the method adopted, either current heating or uniform heating or a possible combination of both; uniform temperature is likely to give the highest value and the most strenuous test.

I am rather surprised that with the limits of six times working pressure for normal breakdown and five times for breakdown after bending—allowing the preliminary steps—the authors suggest a value of five times W.P. as the installation direct-current testing pressure. Since the installation test is a try-out for the possibility of bad work and mechanical damage, it would seem that the d.c. test equivalent to the given a.c. value of twice working pressure would be the peak value of this, say as a maximum three times W.P. Above the factor of safety of the cable—a somewhat indeterminate quantity—high voltage even for a short period will cause some permanent deterioration of the dielectric, which makes it inadvisable to test at any higher voltage than is considered absolutely necessary, either with d.c. or a.c. It would be interesting to know why there is such a tendency to push up the figure for the equivalent d.c. voltage, and what definite research and experimental investigation there has been to substantiate such confidence. In general I must congratulate the authors on a just and broadminded attempt to accomplish a difficult task, which I trust will be properly appreciated by those concerned with the important subject of super-tension cables.

E. A. Beavis.

Woolwich, *November 29th*, 1927.

The article in your issue of November 25th on "Testing 33-kV Cables," by Mr. Höchstadter and Dr. Bowden, was very opportune. The procedure outlined by the authors is well known in manufacturing circles, but is comparatively unknown among users of high-voltage cables.

Your contributors' programme of tests is open to little comment except perhaps on the ground that it might even be amplified without making cable testing unduly involved.

With regard to dielectric resistance, it is, of course, necessary to ensure that this has some tangible value, but such value can be as readily ascertained with 50 volts as with 1,000 volts provided the galvanometer be sufficiently sensitive. What would really be of value would be determination of the time-current relationship or electrification curve using a unidirectional voltage sufficiently high to really stress the dielectric. As has been proved in another branch of cable work this test, carried out with due precautions, is a sure guide regarding the soundness of a dielectric and it can readily be applied in these days of valve rectifiers.

It is difficult to assign suitable limiting values to dielectric resistance in megohm-miles. Anything less than 100 megohm-miles or so will seldom be met in a cable capable of standing up to an ordinary routine stress test. On the other hand the present writer is well acquainted with very excellent cables which have a dielectric resistance rather higher than 750 megohm-miles at 60 deg. F. The real criterion in this sphere is that the value in megohm-miles should be reasonably consistent in association with any particular compound.

Coming now to capacity tests, there is some misconception in existence as to the effective value of capacity in cables of the "H" or "S.L." types. The present writer has seen a schedule which asked for the values of the capacity of all cores bunched against earth; this in an "H" cable is precisely three times that of one core and it was in this instance in danger of being taken for the effective three-phase capacity. It might be made clear that in any three-phase cable the "equivalent star capacity" is twice the mutual capacity measured between any two cores (all testing apparatus being insulated from earth); this where an "H" or "S.L." cable is concerned is the capacity of any one core to earth.

The breakdown and bending test can with advantage be extended to include a series of time-voltage breakdown tests. If the quality of the cable insulation is unform the results will be found to comply with a definite law. The information so gained is well worth the cost of the cable required when an order for a number of miles is concerned.

The stability test is the real acid test of an extra-high-voltage cable; by its means any tendency for the formation of voids, due to heating and cooling with variation of load, is readily disclosed. The formation of such voids, of sufficient magnitude to cause ionisation at working stress, is undoubtedly the main cause of failure of 33-kV cables.

Tests after installation are generally made with unidirectional voltage, and considering that the detection of moisture and dirt is the main object of such tests this type of stress has advantages over alternating voltage. In the present state of knowledge regarding the effect of direct stress on impregnated paper insulation it is necessary to guard against the use of too high a pressure. The authors limit the value of direct voltage to five times working pressure, which would appear to be on the high side. The present writer would prefer to use a value of say $\sqrt{2}$ times working pressure and supplement the test by observing the apparent leakage current during the test. The time-current curve should then closely correspond with that obtained for the same cable during factory tests at the same voltage. Two short periods of opposite polarity are probably preferable to a longer period with one pole to earth for the whole time.

A test such as here outlined could be applied periodically throughout the life of the cable without harm, and as shown by the work of Messrs. Phelps and Tanzer in America, would often forestall the failure of cables on load. There is ample evidence that repeated over-stress tests can do much harm. The number of transients of triple voltage which would be required to do as much damage as a fifteen-minute test at three times working pressure can be calculated by dividing fifteen minutes by the duration of one such transient.

The importance of this absorbing subject is my only excuse for trespassing on your valuable space to this extent.

M. C. Timms.

Leeds, *November 29th*, 1927.

I have read with interest the article on "33,000-volt Cable Testing" by Messrs. M. Höchstadter and E. Bowden in your issue of November 25th, but I am disappointed from the technical standpoint with their specification for certain of the factory tests.

Dielectric resistance: The variation in the testing pressure suggested is much too wide. For many years it has been customary to determine the dielectric resistance with a pressure of 500 volts, and it is suggested this value should be adopted when testing 33,000-volt cables. It is not clear whether the limits of dielectric resistance specified, *viz.*, 180 to 750 megohms per mile, refer to all sizes of 33,000-volt cable; if so, this does not appear satisfactory. On the other hand, the limits suggested are very wide for a given size of cable.

Pressure test: The temperature at which the test is to be carried out is not specified, and presumably atmospheric temperature is intended. This is fundamentally wrong, as also is the "three times the actual working pressure for three minutes." The following test would indicate better whether the cable was likely to withstand service conditions than that suggested in the article:—

> The cable shall be heated in a tank at a temperature of 50 deg. C. (conductor) for one hour, and then an alternating test pressure (50 c.) 50 per cent. above the working pressure shall be applied to the cable and maintained for six hours. The temperature of the conductor shall be maintained at 50 deg. C. (± 2 deg. C.) throughout the test.

Breakdown test: This test should be omitted, as it is of little value in the determination of whether or not the cable will be satisfactory in service.

Bending test: The effect of bending the cable should be determined by obtaining a power factor-voltage curve before and after the test, in accordance with the details given under "Dielectric Loss."

H. C. C. C. Silver.

Wallington, Surrey, *December 1st*, 1927.

The Perfect Clock.

Regarding Mr. C. Turnbull's article, "The Quest for the Perfect Clock," in to-day's ELECTRICAL REVIEW, I am surprised at the author's statement to the effect that "the removal of a ton of coals from the cellar has been known to affect a sensitive clock to an appreciable extent, which shows the necessity for freedom from gravitational disturbance."

I suggest that the removal of a ton of coals, in such a manner as to subject the clock to practically no mechanical injury, will have very little effect on the periodic time of its pendulum; for example, the absence of a mass of one ton from a position ten feet below the clock should cause the latter to be one second slow about 87 years subsequent to the removal.

Regulator.

December 2nd, 1927.

Trolley 'Buses and Radio Reception.

Radio listeners, situated near overhead trolley-'bus routes, experience considerable difficulty in getting satisfaction from their sets owing to the interference from the trolley wires. It is generally an easy matter to eliminate unwanted radio waves, but the effects of the trolley-'buses present a difficulty. I should be obliged if any of your readers could suggest a method of dealing with the problem, in such a way that the quality of the reception, and the range of the radio receiving set, would not be affected.

Horace J. Arthur.

Wolverhampton, *December 4th*, 1927.

The Economics of Electricity Supply.

Your correspondent, Mr. A. W. Blake, is quite right in supposing that it was not my intention to illustrate tariff construction in my article. Such a thing can very well be done in a two-part diagram of this sort, and was to some extent attempted when I first published the diagram a year ago, but the recent article was (as its name implied) primarily a comparison between three different years. In order to show more in a single diagram it would be necessary to group consumers of approximately similar characteristics, whereas my summary was an average for the whole country. Of the three main variables in the problem, load factor, diversity factor, and distribution expenses, only the first-named is fully differentiated in the diagram, the other two being averaged.

In attempting to make an "average" treatment cover the extremes mentioned, namely, the domestic consumer and the purchaser in bulk, the following points must be remembered:—

No one would suggest a two-part tariff to cover all domestic consumers, still less that the standing charge should be based purely on maximum demand. But even if it were, the figures I gave would have to be modified, since the diversity factors of such low-load consumers would be far greater than the average assigned to the country as a whole, and this would proportionally reduce their charge per kW of demand.

As regards bulk supplies, since the average overall figure of 2d. per unit illustrated in the diagram includes an income (about 45 per cent. of the whole) from domestic consumers averaging 5.3d. per unit, it follows that the remainder is at a much lower figure; and the difference is probably greater than is justified purely by differences in load factor, and therefore greater than is shown in the diagram.

With the main contention of Mr. Blake's letter I am in perfect agreement: even if it were economically justifiable (and this is a point on which authorities differ), there is no use in loading the kW charge beyond what it can bear—the object should rather be to meet public needs as fully as possible whilst showing a reasonable profit on the enterprise *as a whole*.

London, *December 3rd*, 1927. **D. J. Bolton.**

The Reliability of a Storage Battery.

With reference to the recent failure of supply in Westminster, when the Houses of Parliament and many important public and business premises were in total darkness for about an hour, it is worth noting that the Central Hall, Westminster, is also supplied by the same mains, and although the electric power supply to this building also failed, yet a bazaar, a public meeting, and certain other functions then taking place were able to continue with a good light furnished from a battery.

This battery consists of 108 cells of 300 Ah capacity installed by the D.P. Battery Company, Ltd., over 15 years ago. Although largely intended for such emergency demands, it is discharged almost daily on a special circuit throughout the public parts of this immense building, maintaining a guaranteed light in corridors and public rooms.

A network or grid with as many interconnections as a spider's web will never reach the stability of a good storage battery when suitably installed.

T. C. Elliott,
For the D.P. BATTERY COMPANY, LTD.

London, *November 29th*, 1927.

A Series Motor Trouble.

Has any reader a solution to offer to the following puzzle? An electrically-driven drilling machine was out of use for a few days, and on being used again rotated in the wrong direction. Despite the reversing of the direction of the current in the field coils and then in the armature, this direction of rotation could not be altered.

Student.

Published Specifications.

Compiled expressly for this journal by a firm of Chartered Patent Agents. The numbers in parentheses are those under which the specifications will be printed and abridged and all subsequent proceedings taken.

1926.

14,466. "Electrical remote-control and signalling systems." Siemens Bros. and Co., Ltd., and H. E. Humphries. June 8th, 1926. (280,254.)
17,178. "Thermionic valves." A. J. Garrod. May 9th, 1927. (280,258.)
19,594. "Electric arc-welding apparatus." Sir B. Longbottom and E. Greenhalgh. August 9th, 1926. (280,270.)
19,595. "Electric switchgear." E. B. Cox. August 9th, 1926. (280,271.)
20,030. "Electric switches." British Thomson-Houston Co., Ltd., and A. G. Salisbury. August 13th, 1926. (280,294.)
20,057. "Wireless receiving sets." C. C. Webb. August 13th, 1926. (280,296.)
20,506. "Apparatus for producing an adjustable preliminary tension with rectified direction in the auxiliary electrode of Rontgen tubes with intermediate electrodes." Dr. M. Liebermann (trading as the firm of C. H. F. Muller). August 21st, 1925. (257,281.)
21,246. "Electric combs for the hair." E. M. Wildey. August 30th, 1926. (Cognate application 23,425/26.) (280,308.)
22,544. "Process of separating impurities out of molasses and sugar-juices by electrolysis." Count J. De Briey. September 13th, 1926. (280,321.)
22,756. "Temperature-control devices." British Thomson-Houston Co., Ltd. (General Electric Co.). September 15th, 1926. (280,323.)
22,928. "Electric switches." V. A. Trier. September 17th, 1926. (280,325.)
24,293. "Electricity meters." R. Amberton and R. H. Barbour. October 1st, 1926. (280,335.)
25,079. "Circuit interrupter." G. S. Lane. October 8th, 1926. (280,338.)
25,504. "Impulse-sending arrangements for telephone systems." Siemens Bros. & Co., Ltd., and H. E. Humphries. October 13th, 1926. (Addition to 280,291.) (280,345.)
25,936. "High tension electric switches." Aktieselskabet Drammens Armaturfabrik. November 23rd, 1925. (261,723.)
26,334. "Insulation of electric conductors." M. Hochstadter. November 21st, 1925. (261,724.)
26,597. "Electrical measuring apparatus." S. Strauss. January 23rd, 1926. (264,792.)
26,875. "Circuit-breakers for use in alternating-current electric circuits." R. H. Barbour. October 27th, 1926. (280,350.)
26,893. "Reflector for incandescent lamps." E. C. R. Marks (L. Poulsen and Co.). October 27th, 1926. (280,351.)
29,636. "Electricity meters." Chamberlain & Hookham, Ltd., and S. James. November 23rd, 1926. (280,366.)
30,569. "Mercury or other vaporisable metal lamps or rectifiers." F. Reynolds and W. T. Slater. December 2nd, 1926. (280,377.)
31,017. "Horns or sound-chambers for sound-reproducers, amplifiers, and like acoustic apparatus." C. J. W. Hanson. December 7th, 1926. (280,381.)
31,253. "Electrical instruments." C. Engelhard, Inc. May 29th, 1926. (271,811.)
31,355. "Apparatus for supplying high-frequency and high-tension currents for diathermy." W. E. Schall. December 10th, 1926. (280,387.)
32,840. "Method of and apparatus for recharging storage batteries." J. D. Broadfoot. December 20th, 1926. (280,396.)

1927.

542. "Photo-electric cells." Telefunken Ges. fur Drahtlose Telegraphie and Dr. A. Karolus. January 8th, 1926. (264,173.)
1,214. "Sparking plugs." P. Metzler. January 14th, 1926. (264,326.)
3,431. "Electric sound-producing apparatus." B. Ames. February 7th, 1927. (280,410.)
6,456. "Arc-rupturing arrangements for electric switches." Siemens-Schuckertwerke Ges. March 13th, 1926. (267,515.)
8,514. "Diaphragms for use in acoustic reproducing devices." C. Menkens. March 28th, 1927. (280,424.)
8,887. "Electric cut-out or protective systems with pilot conductors." Forges & Ateliers de Constructions Electriques de Jeumont. May 7th, 1926. (270,660.)
10,091. "Method of manufacturing high ohmic resistances." B. Loewe and Loewe-Radio Ges. April 12th, 1926. (269,538.)
11,283. "Magneto-electric lighting machines for cycles and motor-cycles." L. Hemmeler. May 10th, 1926. (270,686.)
12,169. "Starting means for mercury-vapour rectifiers and like apparatus." General Electric Co., Ltd., and E. Weintraub. May 6th, 1927. (280,438.)
12,798. "Electrodes for high ohmic resistances and the like." Loewe-Radio Ges. May 12th, 1926. (271,098.)
12,799. "Submarine signalling." W. E. Beatty (Bell Telephone Laboratories, Inc.). May 12th, 1927. (280,440.)
13,379. "Electric hand lamp." A. E. O'dell (Elektrotechnische Fabrik Schmidt & Co., Ges.). May 18th, 1927. (280,444.)
13,923. "Electrically operated water-heaters." S. D. Nesmith. May 24th, 1927. (280,448.)
13,953. "Electrically illuminated pencil-holders." F. Lochmann. February 22nd, 1927. (280,450.)
14,316. "Electric switch." G. H. Hart. May 27th, 1927. (280,455.)
14,486. "Electric switches." British Thomson-Houston Co., Ltd. June 21st, 1926. (272,882.)
14,488. "Electric regulating systems." British Thomson-Houston Co., Ltd. June 24th, 1926. (273,264.)
14,875. "Device for actuating electric switches." Maschinenfabrik Oerlikon. June 14th, 1926. (272,408.)
14,910. "Automatic electric quick-break switches." B. R. Wingfield. June 11th, 1926. (272,499.)
15,103. "Damping of oscillations of traverse arms of high-tension electric cable masts." F. Berg. June 7th, 1927. (280,458.)
15,154. "Process for the electrolytic extraction of pure aluminium from crude aluminium alloys and the like." Aluminium-Industrie-Akt.-Ges. June 7th, 1926. (272,246.)
16,243. "Light signals." General Railway Signal Co. August 10th, 1926. (275,942.)
17,239. "Commutators for dynamo-electric machines." R. Bosch Akt.-Ges. July 22nd, 1926. (274,837.)
17,551. "Methods of controlling three phase motors with reverse-current braking, particularly for crane-driving and like purposes." International General Electric Co., Inc. July 1st, 1926. (Addition to 251,503.) (273,740.)
17,552. "Suspension canopies for lighting apparatus." British Thomson-Houston Co., Ltd. July 1st, 1926. (Addition to 271,455.) (273,751.)
18,446. "Sparking plug." G. Mickel. October 19th, 1926. (279,388.)
19,050. "High ohmic resistance unaffected by temperature." Dr. S. Loewe. July 19th, 1926. (274,505.)
19,147. "Circuit controllers for electric traffic signalling systems." British Thomson-Houston Co., Ltd. July 26th, 1926. (274,867.)
20,443. "Electrical tumbler switches." W. J. Charles and A. Watson. July 22nd 1927. (280,473.)
20,676. "Electric lamps." W. J. Cameron. August 5th, 1927. (280,146.)
21,219. "Metallic filaments for electric incandescent lamps." R. Stewart. September 18th, 1926. (277,634.)
22,003. "Heating units for electric cooking stoves." C. C. Armstrong. August 3rd, 1925. (Divided application on 256,256.) (276,361.)
22,004. "Electric cooking stoves." C. C. Armstrong. August 3rd, 1925. (Divided application on 256,256.) (276,362.)
22,804. "Unit for use in radio receiving sets of the supersonic or superheterodyne type." Igranic Electric Co., Ltd., and G. A. Mower. August 20th, 1926. (Divided application on 279,580.) (280,149.)
28,257. "Electrical remote-control and signalling systems." Siemens Bros. and Co., Ltd., and H. E. Humphries. June 8th, 1926. (Divided application on 280,254.) (280,485.)
28,258. "Electrical remote-control and signalling systems." Siemens Bros. and Co., Ltd., and H. E. Humphries. June 8th, 1926. (Divided application on 280,254.) (280,486.)

Trade Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from November 30th:—

S.G.E. (lettering and design). No. 479,758. Class 6. Railway signalling machinery and parts thereof.—Siemens and General Electric Railway Signal Co., Ltd., Caxton House, Westminster, S.W.1.

Toreador. No. 484,564. Class 8. Radio receiving sets.—Dubilier Condenser Co. (1925), Ltd.

Bow & Arrow (design only). No. 482,661. Class 8. Instruments, apparatus and parts thereof for use in radio-telegraphy and telephony.—Bowden Wire, Ltd., Victoria Road, Willesden Junction, N.W.10.

Brustow. No. 480,405. Class 18. Electric lighting plants.—R. A. Lister and Co., Ltd., Dursley, Glos.

The Industrial Welfare Society.

The annual meeting of the Society was held on November 29th. The Duke of York presided, and, in the course of his opening speech, said that he knew from conversations which he had had with employers how much the practical work of the Society was appreciated.

Lord Invernairn (chairman), in presenting the ninth annual report, said that it was a record of good work accomplished in a quiet manner. He was of the opinion that the membership would be enormously increased if employers realised the advantages to be gained by having at their disposal such a fund of information and experience relating to questions of management as the Society possessed.

The accounts show a loss of £308, making the accumulated deficit £1,936. It is confidently expected that, as the outcome of efforts now being made, this debt will be speedily liquidated.

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

ACCRINGTON.—Adaptation of Park Side House as Labour club; secretary, Trades Council.

ANDOVER.—Secondary school (£23,000); Surrey Education Committee.

ASHBOURNE.—Waterworks pumping station, Rodsley, for the U.D.C., Dr. Herbert Lapworth, engineer, 25, Victoria Street, Westminster, London.

AUDENSHAW.—Garage, repair shops and sheds; James Robertson & Sons.

AUSTRALIA (ADELAIDE).—Factory, Synagogue Street; Kodak (Australia), Ltd. Extensions, bank, King William Street; Commercial Bank of Australia.

BEDFORD.—Stores, Queen's Engineering Works; W. H. Allen, Sons & Co., Ltd.

BILLINGHAM (DURHAM).—Works extensions, for Imperial Chemical Industries, Ltd.

BIRKENHEAD.—Clinic, Park Road West; borough engineer.

BOOTLE.—Elementary school, Marmion and Pennington Avenues; Director of Education.

BOSCOMBE DOWN (WILTS.).—Aerodrome (£250,000), for the Air Ministry; A. Carkeek & Sons, contractors, Redruth.

BOSTON.—Extensions to hospital; Ald. A. Cooke-Yarborough, secretary.

BRANDON COLLIERY.—School, for Durham E.C.; F. Willey, architect, 34, Old Elvet, Durham.

BRIGHTON.—Enlargement of Dorset Gardens Wesleyan Church (£14,000); trustees.

BURSLEM.—Workshops, office and stores, Leek New Road; Shenton Bros. Hospital, High Lane; New Haywood and Tunstall Hospital Committee. Electricity supply, Hanover Street; Charlton & Thompson, Ltd.

BURTON-ON-TRENT.—Adaptation of girls' high school as art school; Education Committee.

CANNOCK.—School, Bridgtown (£8,500), for the E.C.; S. Harrison, architect.

CHEADLE AND GATLEY.—Additional housing scheme (60), for the U.D.C.; surveyor.

COLCHESTER.—Theatre, with cafés, Headgate, for the Bostock Syndicate, Glasgow and Ipswich.

CROYDON.—96 houses, Mitcham Road estate; borough engineer. Additions and alterations, 73, North End; Barclay's Bank, Ltd. Additions, Salvation Army hall, Brighton Road; W. B. Booth. Shops and offices, 79-81, High Street; C. H. Ridge, Katherine Street.

DARLINGTON.—Schools, Cockerton, for the Roman Catholic managers; secretary.

DONCASTER.—Electric greyhound racing track, for Doncaster Greyhounds, Ltd.; P. A. Hinchliffe, architect, Victoria Road, Barnsley.

DUCKMANTON.—School, for Derbyshire E.C.; H. Wilfrid Skinner, clerk, Derby.

DUNDEE.—Roman Catholic church and presbytery, north end of city; Roman Catholic Rural Dean.

EASTBOURNE.—Housing scheme (62), for the T.C.; Leslie Roseveare, borough engineer.

EASTLEIGH.—Senior girls' school; Surrey Education Committee.

EDLINGTON.—Mining centre, for West Riding E.C.; H. Cooper & Son, Ltd., Conisborough.

FALKIRK.—96 houses (£28,300), for Corporation; burgh surveyor.

FENTON (STAFFS.).—Electricity supply, Fenton Potteries, Victoria Place; Baker & Co., Ltd.

FOLKESTONE.—Houses (38), for the T.C.; G. Lewis and Sons, builders, Dover.

GLASGOW.—Buildings, Wallace Street and Centre Street; Campbell, Achnach & Co. Church in Kelvinside; Taylor Thomson, architect, 212, Bath Street. 74 houses at Meikle Aikenhead; Mactaggart & Mickle, builders, 65, Bath Street.

GRIMSBY.—Tram depôt, Victoria Street; tramway manager.

GUILDFORD.—Factory, Bury Street; Guildford Glass Works. Church and Sunday schools, Southway Avenue; C. T. Bateman, secretary, Guildford Congregational Church.

HALIFAX.—Operating theatre for St. Luke's (Union) Hospital (£15,427); clerk, Board of Guardians.

HAMILTON.—Cinema; H. N. Bryden, La Scala, Motherwell.

HANLEY.—Electrification of kiln, Eagle Pottery, Ivyhouse Road; J. & G. Meakin, Ltd. Race track stands, &c., Sun Street; Northern Greyhound Racers (Hanley), Ltd.

HEANOR.—Additional 200 houses, for the U.D.C.; surveyor.

HULL.—Clinic, Holderness Road (£9,000); city architect. Second block of flats, New George Street area; city architect. Admission hospital and nurses' home, Mental Hospital; city architect. Church, Chanterlands Avenue; Rev. J. Mitchell, for Presbyterian Church Extension Committee.

KILMARNOCK.—Reinstatement, after fire, of the George Picture House, West George Street, electrically equipped; the manager.

LANARKSHIRE.—Health institute at Bellshill (£8,000); the medical officer, Hamilton.

LEICESTER.—78 houses, Catherine Street; Bambury and Sowden. Police buildings, Charles Street (£36,000); Col. J. C. Baines, D.S.O. Artificial light annexe, Isolation Hospital; T. R. Price & Co.

LICHFIELD.—Beet-sugar factory, Elford, for Sugar Industry Auxiliaries, Ltd., London.

LINCOLN.—Additions, Bracebridge Mental Hospital; A. Hall, architect, Silver Street.

LONDON (WEST HAM, E.).—Vapour baths, Plaistow (£14,645), for the T.C.; borough engineer.

(MUSWELL HILL, N.).—12 garages, showrooms, and workshop, Colney Hatch Lane; W. Ellyatt & Co.

(ST. MARYLEBONE, N.W.).—Buildings, site of 508-510, Edgware Road, and 2-4, Lyons Place; Hall-Jones and Dewhurst.

(PECKHAM, S.E.).—Business stores, Rye Lane, for the Royal Arsenal Co-operative Society, Ltd., Woolwich; secretary.

(KENSINGTON, S.W.).—Shops extensions, 188-190, Portobello Road; Hillier, Parker, May & Rowden.

LOUGHTON (ESSEX).—Houses (32), for the U.D.C.; Warriner & Herd, Ltd., builders.

MELKSHAM.—Block of shops and houses, Bath Road, for A. W. Hunt.

NANTWICH.—Additional 36 houses, for the R.D.C.; surveyor.

NEWCASTLE-ON-TYNE.—Extensions, Virgin Mary Hospital; J. Oswald & Son, architects, Worswick Street. Extensions to premises, Northumberland Street, for Boots' Pure Drug Co., Ltd.; P. E. Bartlett, company architect, Station Street, Nottingham.

NEWHAVEN.—Pier (£100,000), for the Southern Railway Co.; engineer.

OLDHAM.—Premises, Yorkshire Street; Westminster Bank, Ltd.

OXFORD.—Additional 220 houses, for the T.C.; J. E. Richardson, city engineer.

ROTHERHAM.—Church and schools, Tenter Street, Thornhill, for the United Methodist trustees; secretary.

ST. HELENS (LANCS.).—Factory extensions, Windle Street, for Barron Walton.

SCARBOROUGH.—Pumping station, Irton (£8,750), for the T.C.; Whitaker & Co., Ltd., builders.

SOUTH AFRICA (CAPE TOWN).—Pavilion at Muizenberg (£86,000); Murray & Stewart, for Corporation. Postal stores; South African Public Works Department.

STIRLING.—Rehousing scheme (30), for the T.C.; burgh surveyor.

STOCKPORT.—Gas purification plant, with elevators, conveyors, &c.; S. Meunier, engineer and manager, Portwood Gas Works.

STOKE-ON-TRENT.—Extensions, tile works, Boothen Road; Barratt & Co.

TROWBRIDGE.—Factory extensions, for Kemp & Hewitt, cloth manufacturers.

TYNEMOUTH.—Traffic clerks' and Customs offices, Albert Edward Docks; Marshall & Tweedy, for Tyne Commissioners.

WEST CHIRTON.—Block of offices; Tynemouth Traction Co., Ltd.

WEST LOTHIAN.—Extension at Armadale Public School (£3,900); Spiers & Co., Glasgow.

WEYMOUTH.—Public library; borough engineer.

YORK.—Extensions, Nunthorpe schools (£4,839), for the city E.C.; H. E. Turner & Son, Ltd., builders.